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FINAL REPORT

EAST FRONT GRIZZLY STUDIES

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MONTANA DEPARTMENT OF FISH, WILDLIFE, AND PARKS

in cooperation with

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April, 1989

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Keith Aune
Project Leader

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INTRODUCTION

In the conterminous 48 states, only six areas are found to contain self-perpetuating or remnant populations of grizzly bears (Ursus arctos horribilis) (US Fish and Wildlife Service 1981). Of these six areas, the Northern Continental Divide population is contiguous with Canadian and Alaskan grizzly bear populations, and stands the best chance of survival in the future. The Northern Continental Divide Ecosystem includes Glacier National Park, parts of the Flathead and Blackfeet Indian reservations, parts of five national forests (Flathead, Helena, Kootenai, Lewis and Clark and Lolo), four wilderness areas (Bob Marshall, the Great Bear, Mission Mountains and Lincoln Scapegoat), and a significant amount of state and private land.

One of the more unique segments of this ecosystem is the Eastern Rocky Mountain Front where the great plains meet the steep north and south running ridges which form the Sawtooth Range, more commonly known as the Rocky Mountain Front range. Here, along a narrow strip exists the last place where the grizzly bear occupies a plains habitat.

In 1977, research was initiated on the grizzly bear along the east slope of the Rocky Mountains in northwestern Montana. The study, which was continued until 1979 by the Border Grizzly Project, provided much baseline data concerning grizzly bear populations, home range, movement, and habitat use (Schallenberger and Jonkel 1980). Research efforts were continued in 1980 through a contract and informal agreements between the Bureau of Land Management and the Montana Department of Fish, Wildlife and Parks and Border Grizzly Project personnel (Aune and Stivers 1981). From 1981-1989 funding was supplied by various agencies including The Montana Department of Fish, Wildlife, and Parks, The U.S. Forest Service, Bureau of Land Management, and U.S. Fish and Wildlife Service. The Nature Conservancy, Williams Exploration Company, Mr. Marcellus Merrill, Superior Oil Company, American Petrofina and Sunmark Exploration Company committed additional funding toward this project (Aune et al 1982, 1983, 1984, 1985,1986 and 1987).

Impetus for continuing research on the grizzly bear in this area was the Endangered Species Act of 1973, the grizzly's listing as a threatened species in 1975, and the BLM, USFS and Department of Fish, Wildlife and Parks' need for information on the species in making resource management decisions. This became especially important because of increased oil and gas exploration and human activities within the study area.

The objectives of the study were: (1) to review and analyze previously accumulated data on grizzly bears, (2) to further delineate and define essential habitat and important use areas within the study area, (3) to determine impacts associated with oil and gas exploration and other human activities, and (4) make recommendations to protect and maintain grizzly populations and habitat. Specific information regarding plant phenology and presence of bear foods, grizzly bear habitat requirements on a seasonal basis, population numbers on a seasonal and year long basis, food habits on a seasonal basis, interaction with other wildlife species, and bear home ranges, movements and distribution were gathered.

DESCRIPTION OF THE STUDY AREA

The study area lies along the east face of the Continental Divide in northwestern Montana (Figures 1 and 2). The northern boundary is Highway 2 and the southern boundary is Highway 200. The study area was bounded on the west by the upper portions of the South Fork of the Flathead River, and the Middle Fork of the Flathead River within the Flathead, Lolo, and Helena National Forests. The eastern boundary extended to approximately Range 6 West. BLM lands, Montana Department of Fish, Wildlife and Parks wildlife management areas, Forest Service non-wilderness and private lands with federal oil, gas and mineral rights were the primary focus of the research.

The study area has been described in Picton (1960), Schallenberger (1966), Knight (1970), Mudge (1972), Erickson (1972), Frisina (1974), Holdorf (1981), Schallenberger (1974 and 1976), Schallenberger and Jonkel (1978, 1979 and 1980), and USDA Forest Service (1977). Picton and Picton (1975), Schallenberger (1974 and 1976), Dupuyer Centennial Committee (1977) and USFS (1977) present historical information from the study area. Information on grizzly bears in the region has been reported by Jonkel (1976 and 1977), Schallenberger (1974 and 1976), Sumner and Craighead (1973), Hamlin and Frisina (1974), Schallenberger and Jonkel (1978, 1979 and 1980) and Aune et al (1981, 1982, 1983, 1984, 1985, 1986 and 1987).

Briefly described, elevations on the study area range from approximately 1280 m. (4200 ft.) in river valleys and plains to the east of the mountains to 2863 m. (9392 ft.) on mountain tops. Sedimentary rocks of the limestone and dolomite types generally form the peaks and high ridges, while rocks of the sandstone type often underlie the valley bottoms. Alpine glaciers extensively modified landforms in the past.

Annual precipitation averages about 31 cm (12 inches) at Choteau and up to 167 cm (65 inches) near the Continental Divide. Approximately 80% of the precipitation falls as snow. Temperatures range from 32° C (90° C) to about -46° C (-50° F). The climate is characterized by long, cool winters, short, warm summers and strong southwest winds. Climatological data from two reporting stations for 1979-87 along the east front are presented in Appendix A.

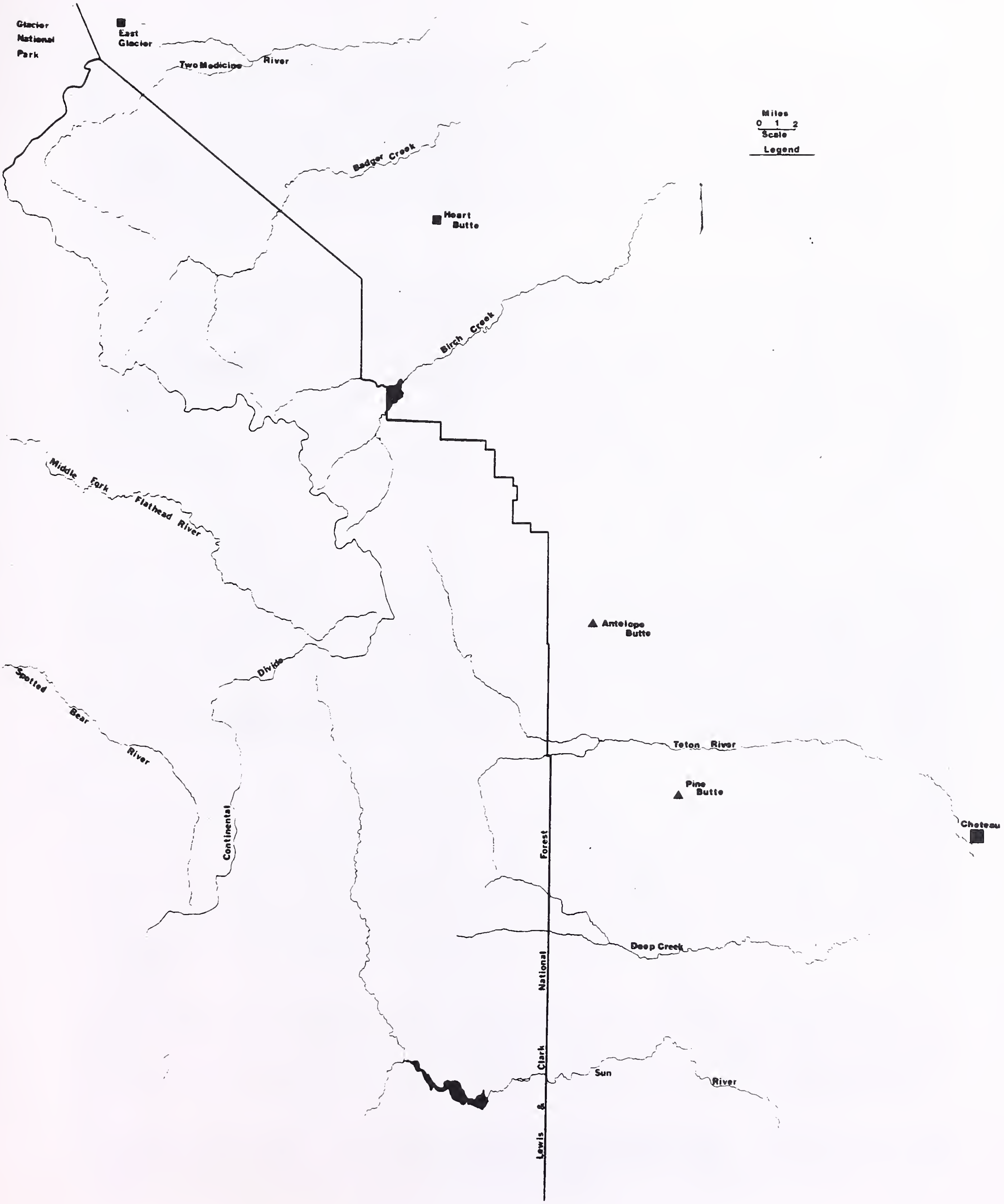


Figure 1. Map of the study area north of the Sun River.

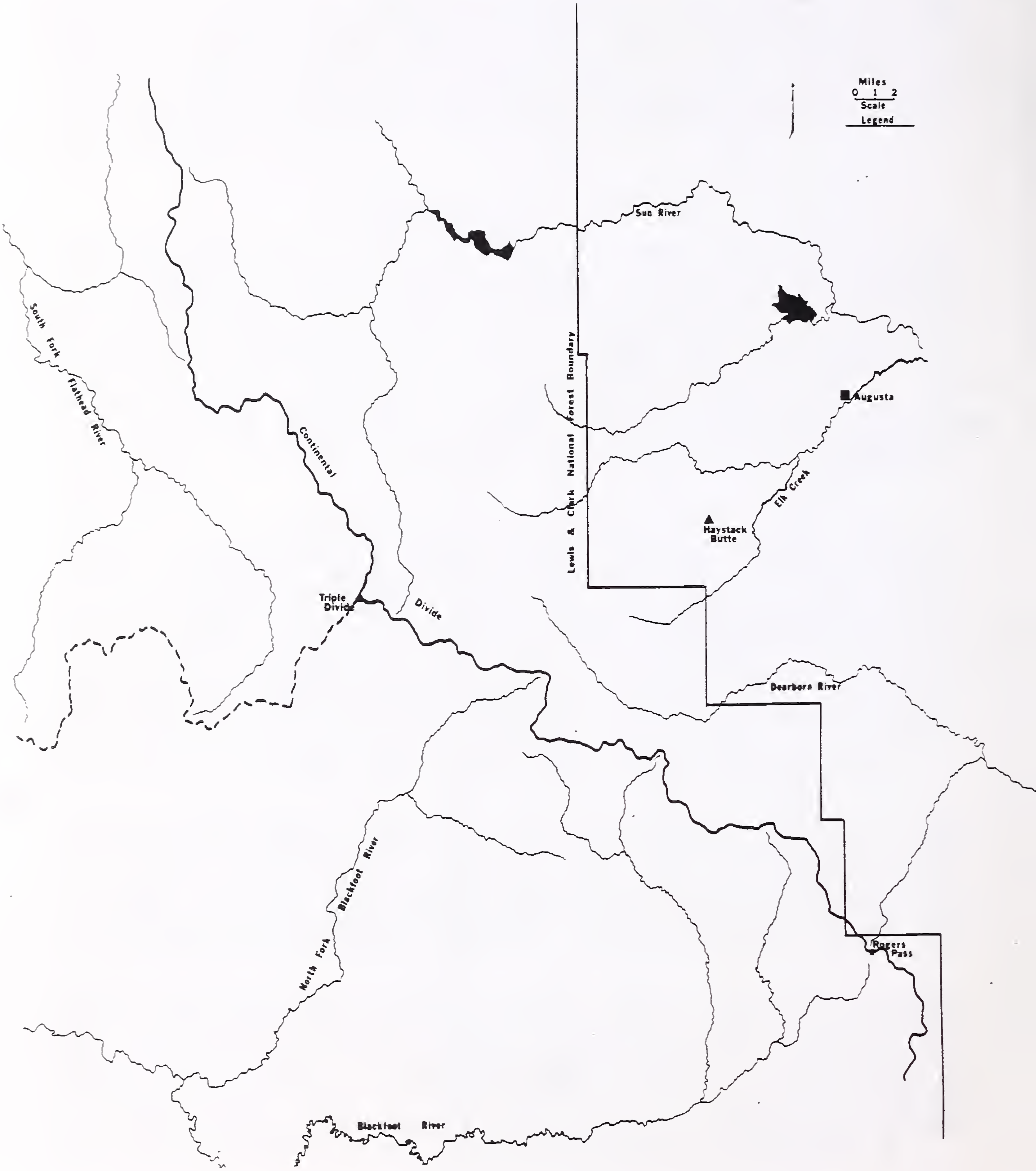


Figure 2. Map of the study area south of the Sun River.

The major drainage systems within the study area include the Dearborn River, Sun River, Teton River, Birch Creek and Two Medicine River. Many of the drainages form a characteristic trellis pattern with narrow canyons joining main rivers at abrupt angles (Mudge 1982). Riparian vegetation extends into the high plains and provides food and cover for black and grizzly bears far from mountainous habitat (Schallenberger and Jonkel 1980, Aune and Stivers 1981, 1982, 1983, Aune et. al. 1984, Aune 1985 and Aune and Brannon 1986).

Subalpine fir (*Abies lasiocarpa*) is dominant and represents climax on most of the timberline forest. Stands of spruce (*Picea* spp.), white-bark pine (*Pinus albicaulis*), lodgepole pine (*Pinus contorta*), Douglas fir (*Pseudotsuga menziesii*), limber pine (*Pinus flexilis*), aspen (*Populus tremuloides*), and cottonwood (*Populus trichocarpa*) are found on select locations, depending on landform, aspect and elevation. Natural grasslands cover the plains and foothills at lower elevations and intergrade westward into limber pine savanna (Schallenberger and Jonkel 1980).

METHODS

Field Methods

Bears were trapped using foot snares (Aldrich Snare Co., Clallam Bay, Washington). Before trapping began, snares were boiled for several hours in bark, needles and leaves from willow, kinnikinnick and juniper. Then the snares were lightly waxed with melted paraffin. All trapping equipment and bait were handled with gloves. Bait included carcasses of road-killed deer, beaver carcasses from trappers, horses, cattle, or miscellaneous meat scraps.

Snares were set at the mouth of log cubbies, on trails, or occasionally a dip or barrel set was made. Cubbies were built and pre-baited before snares were set. A drag, which consisted of a piece of ripe bait on a rope, was pulled between each snare set and along bear travel routes to attract bears to the set. Warning signs were posted announcing the general location of the set to minimize human/bear encounters. The traps were checked daily by vehicle or with saddle horse and pack string.

Captured bears were darted with a Palmer Cap-chur gun. Phencyclidine hydrochloride (Sernylan) and promazine hydrochloride (Sparine) mixed in equal portions were used to immobilize grizzly bears. A 2:1 ratio of ketamine hydrochloride (Ketaset) and xylazine (Rompun) was used on small grizzly bears and black bears.

Grizzly and black bears were marked with two numbered and colored plastic ear tags. One tag was placed in each ear. A numbered lip tattoo which matched the ear tag number was applied to the inside upper lip.

Grizzly bears were fitted with radio transmitters in the 164 MH range (Telonics, Inc., Mesa, Arizona). Ear tag transmitters (Telonics, Inc., Mesa, Arizona) were fitted on a few yearling grizzlies. Small grizzlies were not collared to avoid problems associated with increasing neck girth of growing individuals and the possible restriction by the radio-collar. All collars placed on subadult grizzlies were padded with foam up to two inches thick or had breakout spacers inserted to allow for expected increases in neck girth over time.

Once trapped and drugged, physical measurements of the bear were obtained. Weight was estimated using a chest girth measurements or bears were weighed using a spring scale. The first premolar was extracted and used to determine age of the bear from cementum annuli counts (Stoneberg and Jonkel 1966).

Radio-instrumented bears were monitored during frequent (twice weekly) aerial flights made in a Piper Supercub. The airplane was equipped with a belly-mounted antenna system. Black and white photos were taken at each location for future reference. Ground tracking efforts were conducted immediately after aerial flights were completed. All locations were plotted on USGS 1:24,000 quad maps by UTM coordinates. Bears were tracked until the radio malfunctioned or the bear died.

Specific radio locations made by ground and aerial tracking efforts were visited to determine the reasons for the bears' presence at each site. Scats, tracks, beds, digging sites, den sites, destruction of rotten logs, dug up squirrel caches, marking trees, hair on fences and other objects, trails, evidence of feeding activity or any other evidence of activity were noted. A 375 m^2 (0.1 acre) circular plot was delineated within the activity site. Plant species phenology and canopy coverage of each were recorded at the site. Vegetation structure was determined by assigning canopy coverage values to structural tree and shrub heights. Plants were identified according to Hitchcock and Cronquist (1973) (Appendix B). The goal was to sample 10% of the locations within each habitat component during the course of the study.

Scats and reports of grizzly bear sightings, tracks, dens, kills and depredations were collected from many sources during the study. Federal and state government agencies, outfitters, guides, hunters, ranchers, and other outdoorsmen cooperated by reporting such information.

Grizzly scats were collected, tagged and frozen. Scats were differentiated as to species when collected from unknown bears. Scats of greater than 2-inch diameter or 1 quart in volume were labeled grizzly bear scats. Some scats were differentiated as to species by keying guard hairs found in beds and on trees or brush or from tracks found near the scat collection site. Most of the grizzly scats collected were from known radio-collared grizzlies.

Activity patterns were determined by 24-48 hour continuous monitoring of individuals. Real time motion sensing collars were placed on bears to increase reliability of activity data. Nonmotion-sensing collars could yield activity data to an experienced observer by interpretation of signal strength. Motion-sensing collars are designed to transmit in two different modes, depending on the collar position. Constant transmission in either mode indicates a stationary collar. Intermittence of mode indicates motion of collar, and bear.

Bears were selected for 24-48 hour monitoring according to their availability and proximity to areas of disturbance. Instrumented bears were ground tracked by foot, horseback, or vehicle, for as long as possible. Observers monitored the bears' every one-quarter to one-half hour, from as close as possible (for maximum radio reception) without disturbing the bear. Activity and locations were determined by triangulation, signal integrity, visual contact, or state of transmitted mode. Information recorded included date, bear number, observers, receiver type, observation time, location of observer, location of bear, signal strength, consistency or intermittency of signal, and transmitter mode.

Dens were located by random chance, helicopter surveys in denning habitat, and radio tracking bears to their dens from air or ground. Dens were inspected on the ground as time permitted. Pertinent data gathered from each inspection included elevation, aspect, slope, habitat type, land type, den type and condition of the den. Dens located by helicopter were photographed with color slide film from low altitudes while hovering above the den.

The current dominant class of livestock grazing at each radio location was reported and coded. Also, each vegetation plot conducted in the field was rated from 0-5 where 0 would describe an area not grazed for 2 years or more and 5 described an area which appeared overgrazed. Ocular estimates were used to appraise the site condition.

Data Analysis

Distribution and Home Range

Observation data were plotted on USFS (½ inch=1 mile) maps to record distribution. Distribution maps for each spring, summer and fall season were prepared. The information collected since 1980 was recorded by UTM's and section, township and range. Each observation represented from one to eight grizzly bears. Radio locations were included as an observation and were plotted on both U.S. Forest Service (½ inch=1 mile) maps and U.S. Geological Survey topographic quadrangle maps. Grizzly observation data were coded then entered into computer files for analysis using Statgraphics computer software.

Grizzly bear home ranges were described by the minimum home range method (Mohr 1947, Hayne 1959) and the modified minimum method (Harvey and Barbour 1965). Home range maps were created with the aid of a Honeywell computer and plotter. The Telday home range program was provided by the Montana Department of Fish, Wildlife and Parks. Area calculations for the minimum home range of each bear were completed on the computer. Modified minimum home range area measurements were done using a planimeter.

Activity Patterns

Activity patterns determined by radio telemetry in 1980-83 were recorded in a slightly different format than during 1985-86 (Aune et. al. 1984). During 1980-83 activity was categorized as stationary active, active, or inactive (Aune and Stivers, 1982). Not all radioed bears were fitted with activity sensitive collars and most monitoring was conducted on the lowland front country. Monitoring was focused on the periods when bears were most active and less intense during the inactive period. Objectives were primarily to define movements rather than to quantify activity patterns.

In 1985 and 1986 activity pattern data collection and analysis followed those described by Garshelis and Pelton (1980). Data were gathered from backcountry and lowland settings. Motion sensitive collars were monitored in all sessions.

Sessions were selected from the 1979-86 activity patterns data which could be formatted into 15 minute monitoring intervals according to methods of Garshelis and Pelton (1980). These sessions were divided into lowland sessions occurring along the low elevations of the Rocky Mountain Front and backcountry sessions occurring in remote wilderness/semi-wilderness settings. Average activity patterns were created for each bear group. Differences in the average hours spent in vigorous versus moderate activity were compared between each group of bears. Vigorous activity was defined as a probability of activity greater than 50%. Moderate activity was defined as a probability of activity less than 50%. A chi-square test was used to test differences between each group in hours of each level of activity. Analysis of variance was used to test the significance of differences between levels of activity for bear groups.

Food Habits

Frozen and dried scats were soaked then washed through two wire mesh screens twice. The first wash, using hot water was followed by a second with cold water. Coarser materials gather in the coarse mesh screen (0.156), while finer materials gather in the finer mesh screen (0.0937 inch). The contents of each screen were then placed in a large porcelain pan. Cold water was added and the scat material examined. Dissecting and compound microscopes were used to aid in identification. Items present were identified as to genus and species when possible. The parts of each item were also identified (e.g., leaf, stem, root, berry, etc.). The percent volume of each item was visually estimated. Data from each scat including information about the collection site were coded on computer sheets. Data were sorted and analyzed by computer methods.

The frequency, percent frequency, total volume, percent volume, percent composition, importance value and importance value percent were calculated. Formulas are presented below:

$$\text{Frequency} = \text{Number of scats having the same item}$$

$$\text{Frequency percent} = \frac{\text{Frequency of item}}{\text{Total number of scats}} \times 100$$

$$\text{Total volume} = \text{Total volume of the same item in all scats of the sample}$$

$$\text{Total volume percent} = \frac{\text{Total volume of item}}{\text{Total volume of scat samples}} \times 100$$

$$\text{Percent composition} = \frac{\text{Total volume of item}}{\text{Number of scats with item}} \times 100$$

$$\text{Importance value} = \frac{\text{Percent volume X percent frequency}}{100}$$

$$\text{Importance value percent} = \frac{\text{Importance value of item}}{\text{Sum of importance values}} \text{ X } 100$$

Den Studies

Dens located by helicopter or inspected on the ground were plotted on USGS and USFS (½ inch = 1 mile) maps by UTM's or section, township and range. Physical characteristics data from dens were derived from both observation (with the aid of color slides) and interpretation of data from USGS quad maps. Physical characteristics data from dens not visited on the ground but accurately plotted on USGS maps by UTM's were extracted from maps and aerial photographs of the area. Physical characteristics data were summarized and put into tables. Data on entrance and emergence from dens by grizzly bears were determined by radio monitoring individuals. When the precise date of entrance or emergence was not known then the date was interpolated between radio locations made before and after denning.

Impacts of Oil and Gas Exploration and Development Activities

Home ranges were mapped in relation to oil and gas drilling and seismic exploration activities. Radioed bears were occasionally monitored for 24 to 48 hour periods in the area of oil and gas exploration/development activities. Grizzly bear movements and locations were plotted by UTM's on USGS quad maps.

Accurate records of oil and gas drilling activity and the associated phases of activity were kept. Seismic activity information was recorded by the USFS. These were plotted on maps for annual recording of activities.

Two methods were employed to test the hypothesis that grizzly bears were displaced by seismic activity and separated their activities both in time and space. The first method involved mapping bear relocations on ½" to 1 mile scale maps for the period of time that a specific seismic project was conducted. Each radio location was dated. Seismic lines were mapped on the same scale and each was separated into sections with appropriate dates when major activities (blasting, helicopter crews, etc.) were prevalent. It is recognized that some preparatory activity (i.e. survey crews) occurred on each section of line prior to the major survey activities. Distances were measured from each radio location to the nearest active seismic line section. Summary statistics were calculated for each radioed bear and all bears pooled.

The second method involved monitoring specific behavioral responses of bears to seismic activity. These were recorded in the field by intense monitoring of individual bears and were reported on a case study basis.

Habitat Studies

Habitat data recorded at each radio location included elevation, aspect, slope, habitat components, land type, site information, topography, decade of burn where they occurred, current grazing regime, photointerpretive type, distance to perennial water, and distance to road. Each radio location was plotted on USGS maps and then information was recorded from maps, air photos or when the site was visited on the ground. Data from specific locations were coded and recorded in computer files. Data were analyzed by the Statgraphics or SPSS statistical programs to determine frequency, relative percent and summary statistics of each input parameter.

Aune and Stivers (1983) discussed the habitat components defined for the East Front. However, in 1984 the component classification used in 1983 was modified. The broader timber component was subdivided into open and closed timber components. These were defined by Aune et al. (1984). Each radio location from 1977 to 1984 was reviewed and reclassified as necessary to accommodate this modification. Habitat component use was described using Statgraphics cross-tabs option to cross-correlate bear activity, elevational occurrence, and season of use for each component.

Seventeen habitat components have been defined for the Rocky Mountain Front study area. These seventeen specific components are often closely associated with each other. For each radio location the exact component utilized by a bear was recorded. However often times a bear was very near a second or associated component. When this occurs, a component association was recorded which gives the component the bear is in first, followed by the associated component. Generally if a bear was located and if a 375 m^2 plot conducted at the site would overlap two components, an association was formed.

Habitat types were recorded according to Pfister, et al. (1977) and Mueggler and Handl (1974). Nonwilderness land types follow Holdorf (1981) and wilderness land types follow Holdorf, Martinson and On (1980). Land type maps of the study area were obtained from the USFS. Photo interpretive type maps were obtained by the USFS. This system was defined by C. W. Brown (1970) for USFS timber inventory (unpubl. data). Data for burns and grazing come from current maps of burn locations and allotment maps provided by the USFS. No maps exist for these parameters outside USFS boundaries.

Vegetation data collected from 375 m^2 circular plots were coded for computer analysis. D-base III was used to sort plots by habitat type or other input parameters. Statgraphics or SPSS crosstabs were used to analyze vegetation data. Tables were generated using the Dbase III report generator.

Habitat availability in relation to roads was determined using nonmapping methods described by Marcum and Loftsgaarden (1980). Composite home range polygons were developed according to methods described in Servheen (1981). Analysis of utilization-availability data followed Nue et al. (1974) and Byers et al (1984).

Habitat Mapping

The study area was divided into six bear management units according to similarity of habitats as well as home range and movements data (Figure 3). Constituent elements were defined as spring, summer, fall and denning habitat (USFS, 1984). Each of the six bear management units (BMU's) were mapped into denning and spring habitat. Summer and fall habitats included the entire unit area. Detailed component maps were available for two BMU's. Detailed component maps identify specific physical/vegetation communities whereas constituent element maps are collections of these detailed communities into important seasonal habitats.

Criteria were developed to define denning and spring habitat from data developed during intensive studies of grizzly bear. Denning habitats and spring habitats were initially described by elevation. From a data set of 68 grizzly bear dens a lower elevational limit was described for each BMU. An elevation of 1950 m. (6400 ft.) and above was used to describe denning rage for 5 BMU's. While one

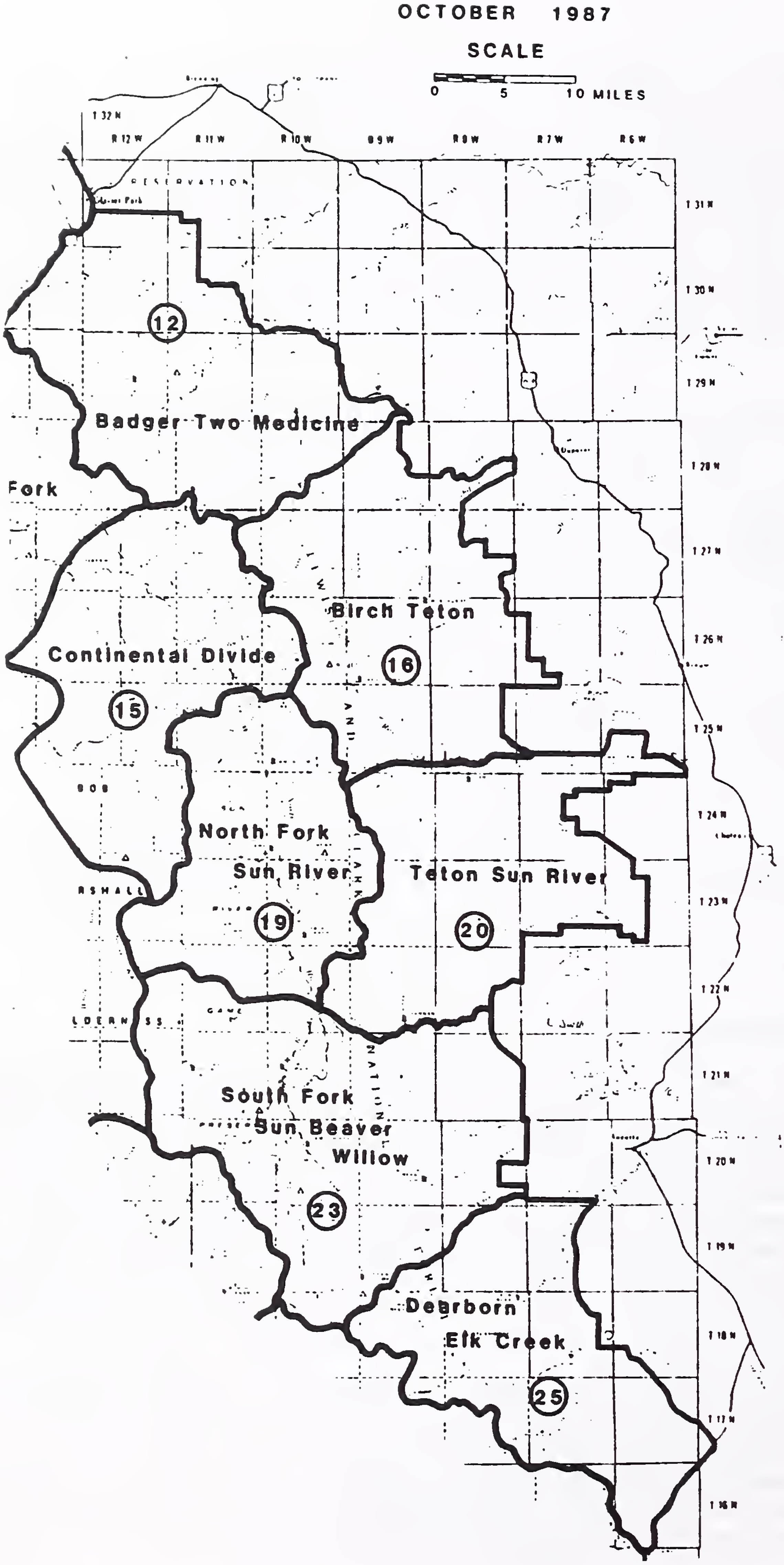


Figure 3. Bear Management Units - Northern Continental Divide Grizzly Ecosystem.

BMU, the Badger-Two Medicine, a 1829 m. (6000 ft.) elevation was the lower limit used to describe denning habitat. Other criteria used to refine this initial separation were land type, slope, and aspect.

Analysis results showed that 90% of spring radio locations were below 1950 m. (6400 ft.) elevation. Spring habitat was then further refined using land type, distribution data, habitat component mapping and I.R. photographs to define the boundaries of major seasonal spring ranges. All mapping was initially conducted on USGS 1:24000 quadrant maps with land type delineations on these base maps. Complete map polygons were then transposed to 1" to mile scale photo reduced composites of USGS quad maps as a base. Area calculations were made using the geoscan program (MDFWP) with a digitizing table-computer linkup.

Population Biology

Records of all marked bears and family groups from marked bears were recorded annually. Sex and age distributions were derived from the sample of marked bears. Recruitment, dispersal, and survivorship estimates were determined from the radio marked sample of grizzly bears.

In addition observations of unmarked bears were kept annually. Most observations of unmarked bears occurred when monitoring marked bears. In many cases observations were of family groups, breeding pairs or sibling groups with marked bears within the group. Other observations used were damage complaint investigations and valid sighting reports from the public.

Evidence of other bears such as tracks and scats found during ground reconnaissance were recorded but were not used in the sighting data files except in two cases. These were when the yearling bears 519 and 335 were captured and the remainder of the family group was not. All other records used in population data analysis were sightings reported to us or recorded by us.

The data from unmarked bears were sorted for independence in order to identify individual bears. Independence of individuals sighted was determined from physical characteristics (primarily age/sex and group size), time of sighting and location of sighting. The number of marked bears present allowed for clearer separation of individuals by reducing the number of unmarked bear combinations to be sorted from the sample. The sorted file of independent sightings and records of marked bears were used to derive density estimates, minimum counts, and female litter size (cubs and yearlings).

A second data file of all observations, including evidence of bears such as tracks and scats, was sorted as described above to determine independent observations of females with young and females with cubs. Evidence of family groups other than those observed allowed for data to be gathered from the entire study region. Few track/scat only sightings were used in the analysis. Most of the records of family groups were sightings.

The independent observations file was used to derive minimum annual estimates of females with cubs and females with young. Female with cubs were summed by three year intervals to establish minimum annual estimates of females present on the entire study area.

Mortality was recorded from all marked and unmarked bears. All radio signals lost prematurely were investigated. If evidence of a mortality occurred, the bear was counted in the mortality records. Other losses of radio contact were not classified as possible mortality. In most cases, confirmation was made of either a radio malfunction or bear movement out of the study area.

Radio days were determined for sex and age groups from the sample of radioed bears including research and management bears. We used only bears captured and marked during the trapping conducted for research to estimate the mortality rate of the overall bear population on the study area. This included research bears which could become problem bears and problem bears captured during the research trapping. For estimation of problem bear mortality we used all bears monitored in the Northern Continental Divide from the time of their first infraction. The Micromort program (Heisey and Fuller,1985) was used to estimate annual mortality rates for both research and management bears.

Density estimates were derived using a technique similar to that described by Servheen (1981), however, we modified the technique by using annual modified minimum composite range as the surveyed area. The modified minimum composite was a better representation of the actual area consistently surveyed in each year by radio telemetry. We examined the annual composite ranges by overlaying each year on the other and looked for consistency in the survey regions between years.

Density estimates were developed for years where some consistency in size and relative location of surveyed area occurred. Years with limited data and which showed significant difference in amount or location of field effort were excluded from analysis.

For density estimation using the marked plus unmarked counts of bears a boundary strip of one-half the estimated standard diameter of annual home ranges was applied to the modified minimum composite range. The boundary strip was not applied on eastern fringes of the occupied range of grizzly bears since this area was mostly prairie and farmland which did not provide habitat for unmarked grizzly bears.

Black Bear Investigations

Methods utilized in black bear investigations parallel those described above. Radio collars were placed only on mature animals. Sub-adults and smaller adults were ear-tagged, but not fitted with radio collars. No site inspections of black bear radio locations were made as time limited the development of these studies. Habitat data were extrapolated from maps, air photos and examination of sites from the air. Black bear habitat use data were analyzed with the aid of computer methods described above.

RESULTS AND DISCUSSION

Trapping and Radio Monitoring

Grizzly bears were captured and marked during both research efforts and management actions. Management bears provided additional information, therefore, data from the monitoring of their activities was collected while they were on the study area. Most management bears were collared and relocated but occasionally some were marked and not collared.

From 1977-87, 61 individual grizzly bears were captured in 105 capture episodes during research and management activities (Appendix C). Forty individual bears were captured and initially marked during research efforts while 21 individual bears were initially captured during management actions (Table 1). One of these management bears died during the capture episode. The remaining 20 were marked and relocated out of the study area. Thirteen grizzly bears were captured and marked during studies conducted from 1977-79 by Schallenberger and Jonkel (1979). The remaining 48 were marked during the period 1980-87. Pertinent biological data was collected from these 61 grizzly bears and are presented in this report.

The marking of 32 research grizzlies was accomplished during regular trapping sessions using aldrich snares, while six additional bears were captured with snares or culvert traps during spot trapping efforts conducted at boneyards and carcasses. In addition, two new marks were put out during helicopter capture operations. The 21 management bears were captured using culvert traps, darting bears while free ranging, snares, or helicopters at depredation sites.

Grizzlies were captured in each of the five BMU's sampled during the study (Figures 4 and 5). No trap efforts were conducted in the North Fork of the Sun River BMU due to its wilderness status and the emphasis of the project on nonwilderness lands.

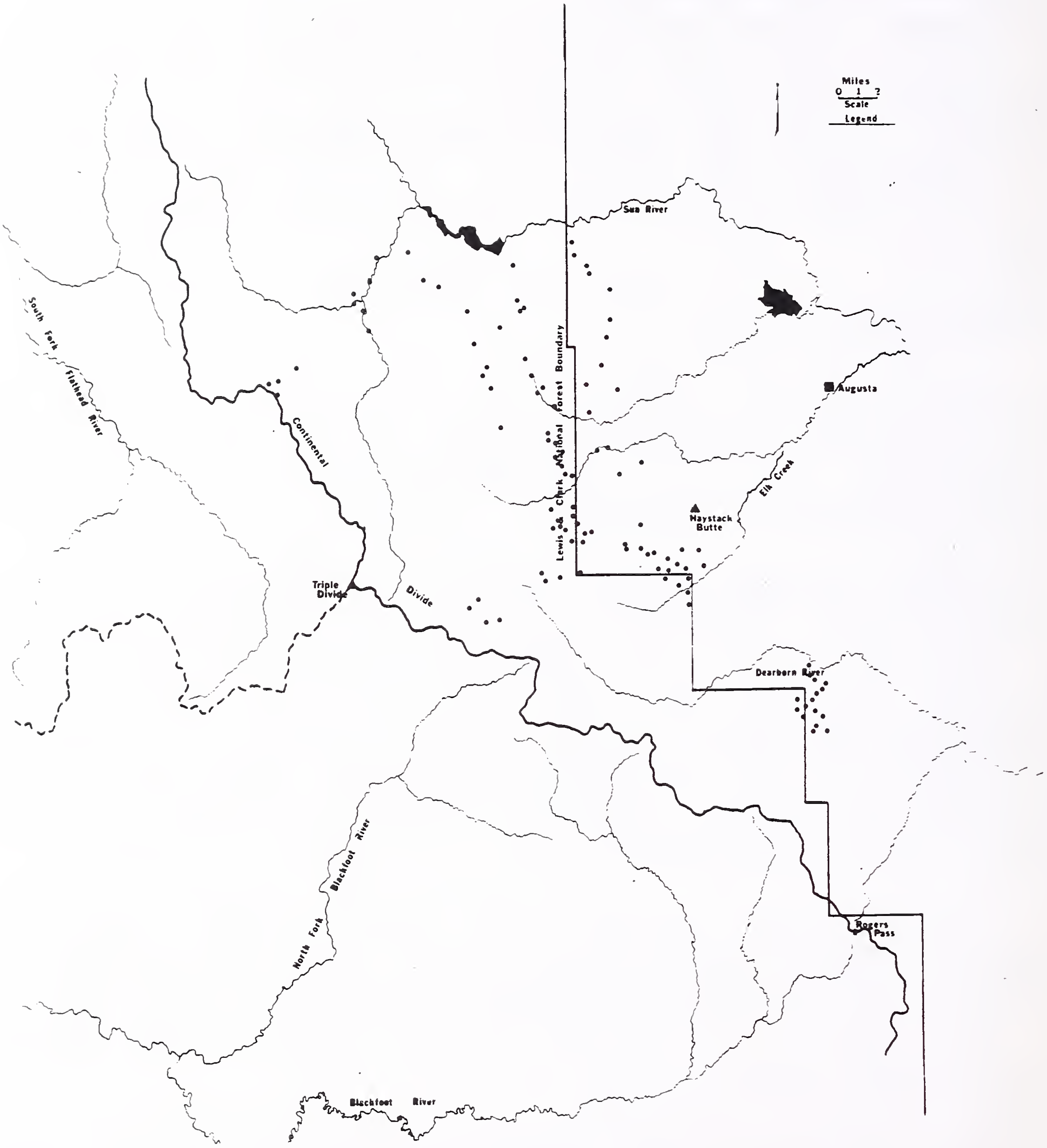


Figure 4. Trap sites south of the Sun River, 1982-86.

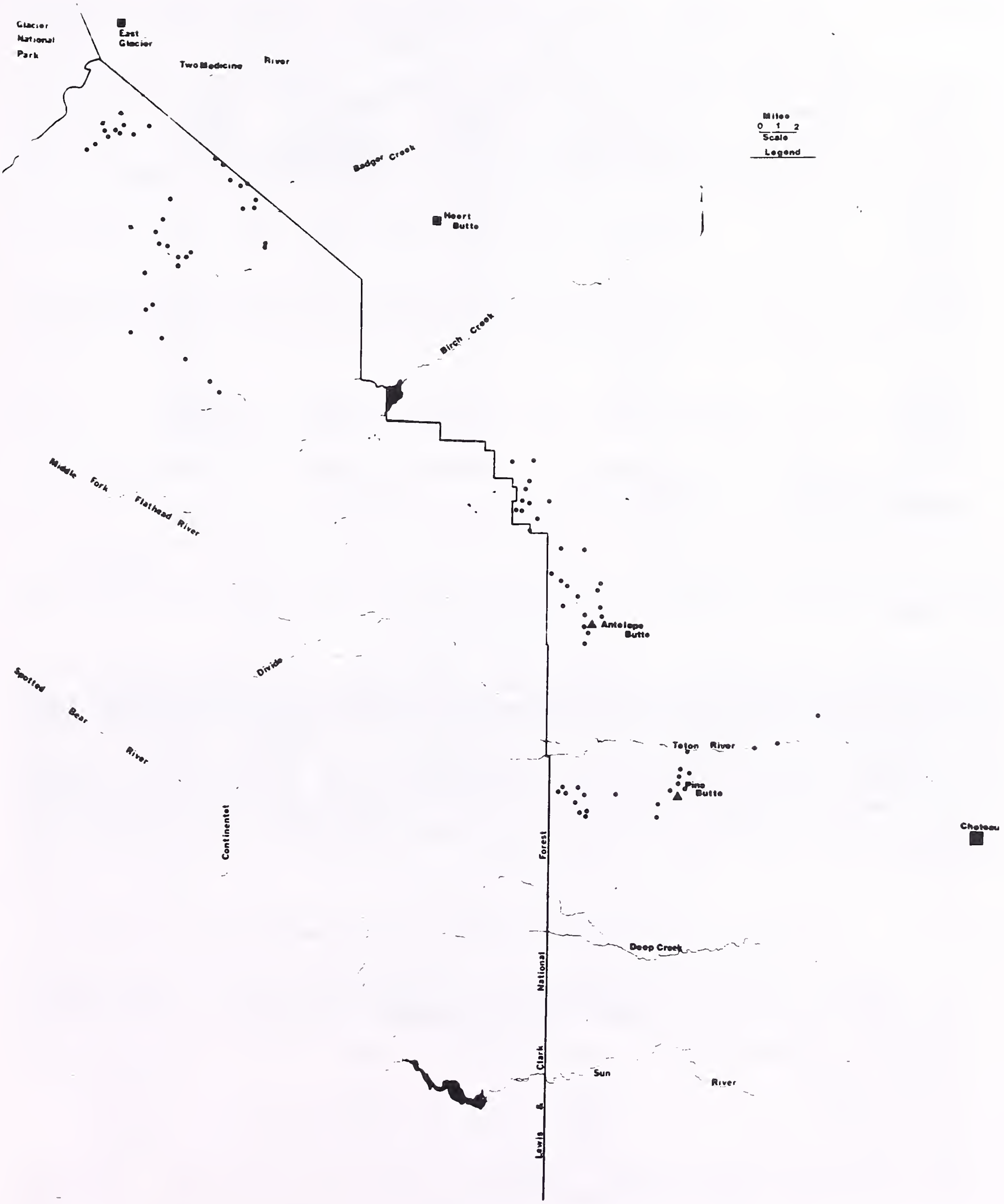


Figure 5. Trap sites north of the Sun River, 1980-86.

Table 1. The number of new grizzly bears marked and capture episodes for each year of trapping effort on the Rocky Mountain Front 1977-87.

Year	Research bears	Research capture episodes	Mgmt. bears	Mgmt. capture episodes	Total bears
1977	3	4	1	1	4
1978	3	4	1	1	4
1979	3	7	2	2	5
1980	3	6	2	2	5
1981	0	5	0	0	0
1982	6	10	0	0	6
1983	5	11	0	1	5
1984	8	12	2	4	10
1985	4	5	6	11	10
1986	5	11	2	3	7
1987*	-	-	5	5	5
TOTAL	40	75	21	30	61

* No research trapping was conducted in the final year of the project.

Trap effort expended to capture an individual bear was highest in the Sun River South BMU and lowest in the Badger-Two Medicine BMU (Table 2). Two units south of the Sun river required nearly twice the trapping effort per bear as compared to the BMU's north of the Sun River. Effort expended to capture and mark 28 individual bears in 23 regular trap sessions was 5152 trap-nites for the period 1980-86. No trapping effort data was available for the period 1977-79.

Table 2. Trapping effort for each Bear Management Unit, 1980-86.

BMU	Number of trap-nites	Number of grizzly captures	Trap-nite/ grizzly
Badger-Two Medicine	778	10	77.8
Teton-Birch	1308	10	130.8
Teton-Sun	605	8	75.6
Sun River South	832	3	277.3
Dearborn	1629	7	232.7

The average effort expended to detect each new individual grizzly bear was 184.0 trap-nites. This is not significantly different than effort expended to capture each new grizzly bear (189.0 trap-nites per bear) during random sampling in the South Fork of the Flathead (Aune and Mace, 1988). Russell et al (1979) report between 93 and 183 trap-nites per individual bear capture for 1975-78 in Jasper National Park. Whereas, in an extremely low density population in the Cabinet Mountains of Montana, Kasworm (1988) expended 1586 trap-nites per individual grizzly.

Ten grizzly bears captured from 1977-87 were not fitted with radio transmitters due to conditions or age (Table 3). Fifty-one grizzlies were fitted with radio transmitters and monitored.

Table 3. Number of marked bears radio instrumented on the Rocky Mountain Front 1977-87.

Year	Research bears	Management bears	Bears not instrumented
1977-79	8	2	3
1980-87	35	11	7

A total of 2633 radio locations were recorded from the 51 grizzlies radio monitored during the course of the study. In addition 153 radio locations were obtained while monitoring 22 management bears.

Radio location data from study bears was composed of 83.2% aerial locations, 13.4% ground locations, and 3.4% other types of location verification. The majority of locations (75.5%) were recorded from the Lewis and Clark National Forest and adjacent privately owned lands (Figure 6). Nine hundred and seventeen (34.3%) of the locations were recorded during spring, while 974 and 742 (37.0% and 28.2%) were recorded during summer and fall.

While being radio located, grizzly bears were observed 22.5% of the time. Other evidence of the presence of bears at each location was obtained for 12.4% of the locations. The remaining locations (65.1%) were not confirmed by sighting the bear or by the evidence of bear sign.

Physical Characteristics

Physical measurements were recorded during 82 grizzly bear captures, 1977-87. Data were recorded for 47 captures of males and 35 captures involving females.

To determine if a relationship existed between female nipple length and age of first reproduction we conducted an Analysis of Variance (AOV) of mean nipple length by age. This analysis indicated that there was a significant difference (P=0.006, N=18) between ages in

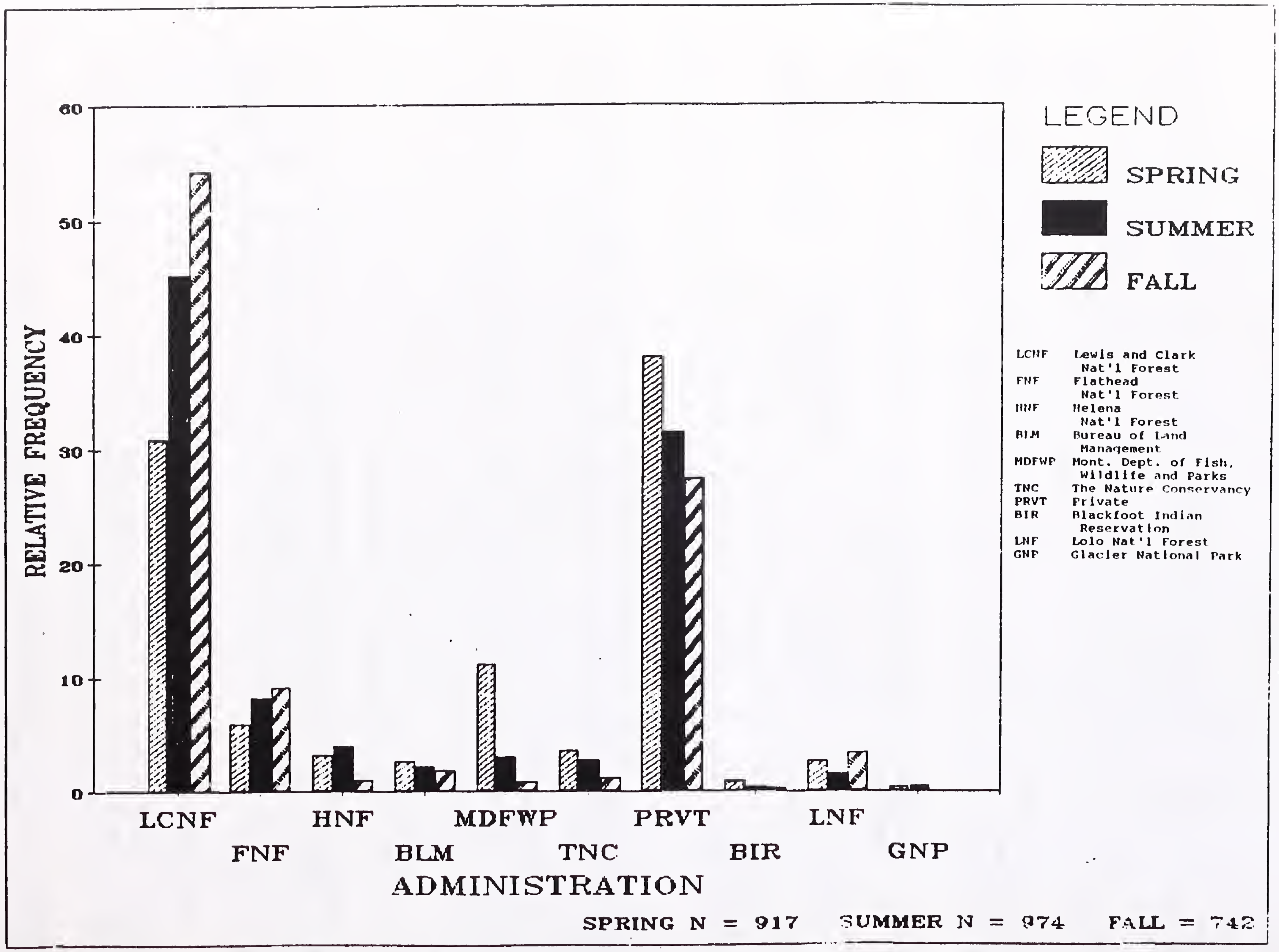


Figure 6. Grizzly bear use by land administration.

mean nipple length. A multiple range test indicated that females five years old and younger had a shorter (P=0.000) mean nipple length than females older than five years (Table 4).

Table 4. Nipple length measurements from female grizzly bears 1980-87.

Age	N	Mean mammae length (mm.)	N	Number of bears lactating	Number w/evidence of estrus
2	3	8.5	3	0	0
3	5	7.9	5	0	4
4	1	-	0	0	1
5	2	8.0	2	0	1
6	1	19.0	1	1	0
7	2	14.4	2	2	0
8	3	15.9	2	2	0
10+	7	20.1	3	7	0

Aune (1985) reported age at first reproduction for two females as 5.0 and 6.0 years old. In 1986 female grizzly 366 was captured in July and was lactating indicating that she had produced cubs at the age of 7.0 years. Her cubs were not observed at that time nor any other time in 1986 indicating that she lost her cubs. The mean age of first reproduction for these three bears then is 6.0 years. Observations from 35 female captures indicate that lactation was not observed in any females less than 6 years of age (Table 3). McLellan (1982) reported that in British Columbia females produced their first litters at age 5.0 years. Craighead et al. (1969) reported a mean age of first reproduction of 6.13 years in Yellowstone and Knight and Eberhardt (1985) reported age of first reproduction as 6.0 years in Yellowstone.

Our analyses indicate that a nipple length of at least 12.7 mm may indicate prior reproduction as the minimum length for females six years old was 12.7 mm. Further evidence supporting this contention is that grizzly 366 had not produced a litter by age 5.0 years in 1984 and her nipple length when captured in June was 9.7 mm. When captured in 1986 after producing her first litter her nipple length was 16.0 mm. Grizzlies 335 and 500 had nipple lengths of 12.7 and 19.1 mm, respectively, when captured in 1985 after producing their first litters.

Scale weights were obtained from 32 grizzly bear captures 1980-86 (Table 5). Due to the difficulty in weighing larger bears few weights were recorded larger than 300 lbs. No adult male bears were scale weighed. Scale weights were slightly larger for males than females for similar age classes. A few bears were scale weighed several times during the study. Scale weights varied across years and seasons (Table 6). One bear (326) lost 15.9 kg. while in the den. Subadult bears gained an average of 37.3 kg. (N=3) each year.

Table 5. Average scale weights from 32 grizzly bears captured on Rocky Mountain Front, 1980-86.

Age class	Males			Females		
	Avg. (kg.)	N	Range	Avg. (kg.)	N	Range
Cubs	46.3	1	-	-	-	-
Yearling	83.1	10	56.8-122.6	52.2	1	-
2	115.8	3	106.7-122.6	105.8	2	93.1-118.0
3-4	129.8	5	86.3-231.5	113.5	4	85.8-163.4
Adults	-	-	-	116.7	6	95.3-163.4
All bears	97.2	18	56.8-231.5	109.9	14	52.2-163.4

Using the scale weight data from grizzly bear captures 1980-87 we derived equations for predicting body weight for males, females and both sexes combined. We used three regressions for predicting weight, the first a log10 - log10 regression of chest girth and weight, the second a regression of a body index (body length times chest girth squared) and weight (McLellan 1982), and the third was a simple exponential regression of chest girth and weight. The fit (as determined by the coefficient of determination) varied with the regression used and the sex class (Table 7). The best fit (r^2=0.95) was for males regressing the body index against weight. The best fit (r^2=0.84) for females was log10-log10 regression of chest girth and weight.

Table 6. Scale weight changes reported across years and seasons from grizzly bears captured on the Rocky Mountain Front, 1980-86.

Bear no.	Sex	Age	Time span	Weight 1 (season) (kg.)	Weight 2 (season) (kg.)	Net gain or loss (kg.)
326	M	1-2	Winter	123(F)	107(Sp)	-16
343	M	0-1	1 yr.	46(F)	86(Su)	+40
316	F	3-5	2.5 yrs.	86(Sp)	163(F)	+77
341	F	1-2	1 yr.	52(Sp)	93(Sp)	+41
366	F	5-8	3 yrs.	95(Sp)	107(Su)	+12

Table 7. Equations for predicting live weights of grizzly bears on the Rocky Mountain Front.

Sex	Equation[1]	R^2	N
All bears	$W=\exp(3.04+0.061(G))$	0.90	32
	$W=18.12+0.00022(I)$	0.86	32
	$W=0.0512(G)^{2.299}$	0.90	32
Males	$W=\exp(2.95+0.064(G))$	0.93	19
	$W=2.89+0.0025(I)$	0.95	19
	$W= 0.0348(G)^{2.411}$	0.92	19
Females	$W=\exp(3.15+0.058(G))$	0.83	13
	$W=39.06+0.0019(I)$	0.70	13
	$W=0.0799(G)^{2.172}$	0.84	13

[1] W=Body Weight, I=Body Index (zoo length (cm.) chest girth (cm.) G = chest girth (cm.).

Although the sample sizes are small the coefficients of determination indicate that it may be possible to estimate body weight using these equations when scale weight is impractical to obtain. Relationships between chest girth and body weight have been reported for all species of North American bears (Payne 1976, LeCount 1977, Sterling et al. 1977, Glen 1980, Kingsley et al. 1983, Nagy et al. 1984, Waddell and Brown 1984).

Using the regression models a weight estimate was made for each of the 82 captures which provided adequate data for predictions. For all males the weight index (McLellan 1982) was used. For females the exponential expression of the Log10-Log10 of weight and girth was used to predict weights for each bear.

The AOV of weight estimates indicated a significant difference ($P<0.05$) in weight estimates between males and females for similar ages. Average weight estimate for males was larger in each age class than for females (Table 8). The largest weight estimate for males was 335.0 Kg. and for females 174.1 Kg.

Growth curves were derived from the weight estimates for males and females (Figure 7). Females do not appear to gain much weight after reaching reproductive age whereas males continue to increase in weight until more advanced age. Similar observations were reported by Glenn (1980), Pearson (1975), and Blanchard (1986).

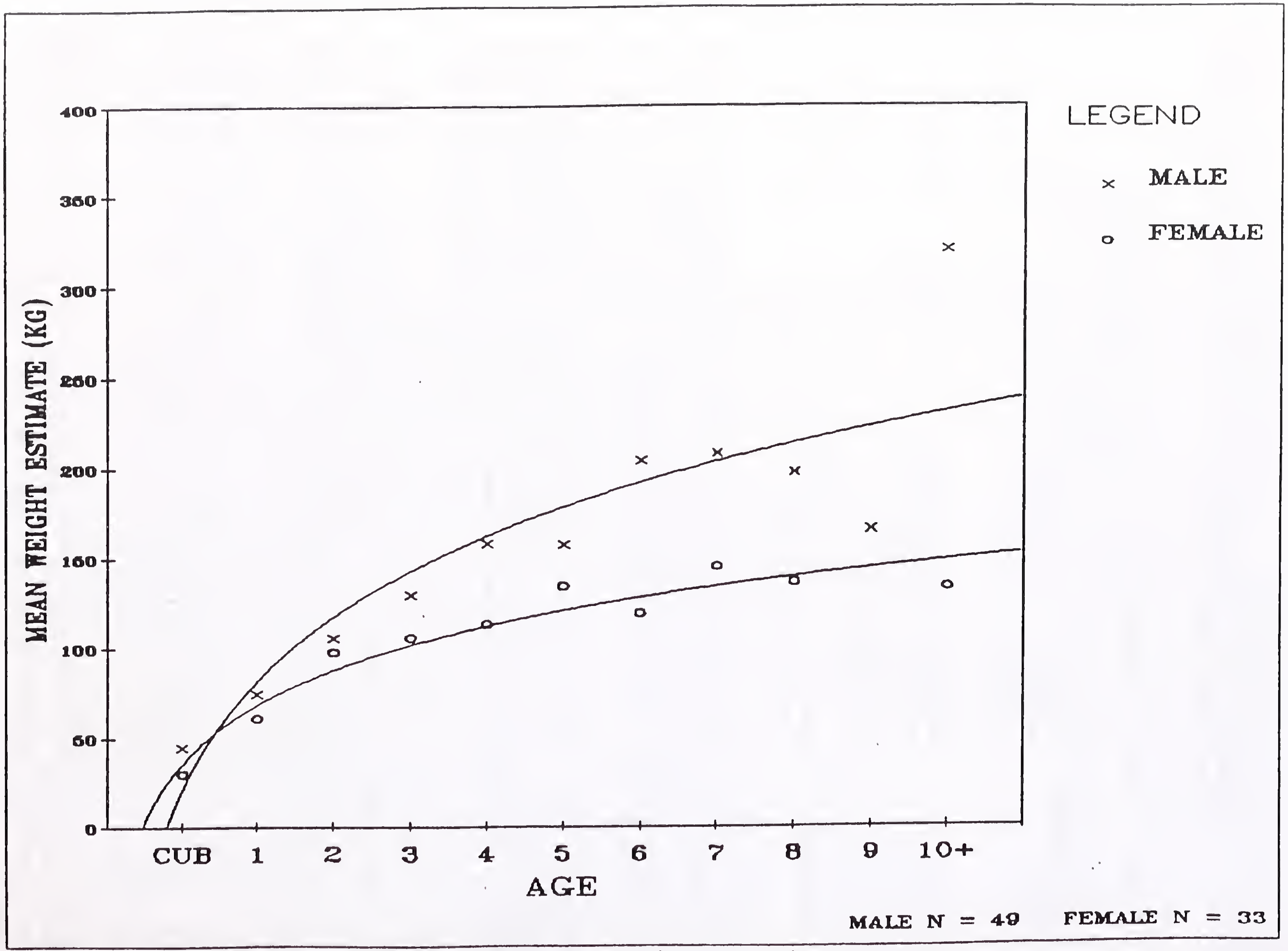


Figure 7. Grizzly bear mean estimated weight by age.

Average weight gains per year for males and females ages cub to five were 22.4 Kg. and 20.7 Kg. Average weight gains for males and females aged six to ten years was 29.2 and 5.0 Kg.

Table 8. Weight estimates (Kg.) for male and female grizzly bears by age on the Rocky Mountain Front.

	Males			Females		
Age	N	Avg.	Range	N	Avg.	Range
Cub	1	45.0	-	1	30.0	-
1	15	74.4	40.9-117.7	4	61.5	52.3- 72.3
2	8	105.1	87.7-126.8	6	97.5	79.5-121.8
3	7	129.1	97.7-190.9	6	105.3	88.6-125.0
4	4	157.4	120.5-215.5	1	112.7	-
5	2	156.8	140.9-172.7	2	133.6	100.9-166.4
6	2	203.6	163.6-243.6	1	118.6	-
7	4	207.6	156.4-245.0	3	144.5	111.4-174.1
8	3	197.1	157.7-231.8	2	136.1	121.8-150.5
9	1	165.5	-	-	-	-
10+	1	320.5	-	7	133.5	109.5-159.1

A comparison of neck circumference, zoological length and chest girth between sexes was conducted. Log regressions by age class revealed very insignificant differences between the sexes for zoological length (Figure 8). It appeared that the chest girth of males may be slightly larger than females after age two (Figure 9). Neck circumference was one measurement taken which measured a muscle mass and indicated a difference between males and females after age two (Figure 10).

These measurements suggest that weight gain patterns of males and females were different primarily due to differences in chest girth and muscle mass and not increased zoological length. Kingsley et al (in Press) reported that length age curves of grizzlies in northern Canada for the two sexes were not significantly different.

Grizzly bears on the Rocky Mountain Front are sexually dimorphic, with females attaining growth earlier than males. Sexual dimorphism was apparent beginning after age two. Blanchard (1986), Troyer and Hensel (1969), and Pearson (1975) also found sexual dimorphism beginning after age two.

Kingsley et al (in Press) speculated that the larger size of males imparted a selective advantage due to the competition for mates and the subsequent need for larger ranges. Whereas females must complete growth early in life and after attaining some minimum size, divert energy into reproduction.

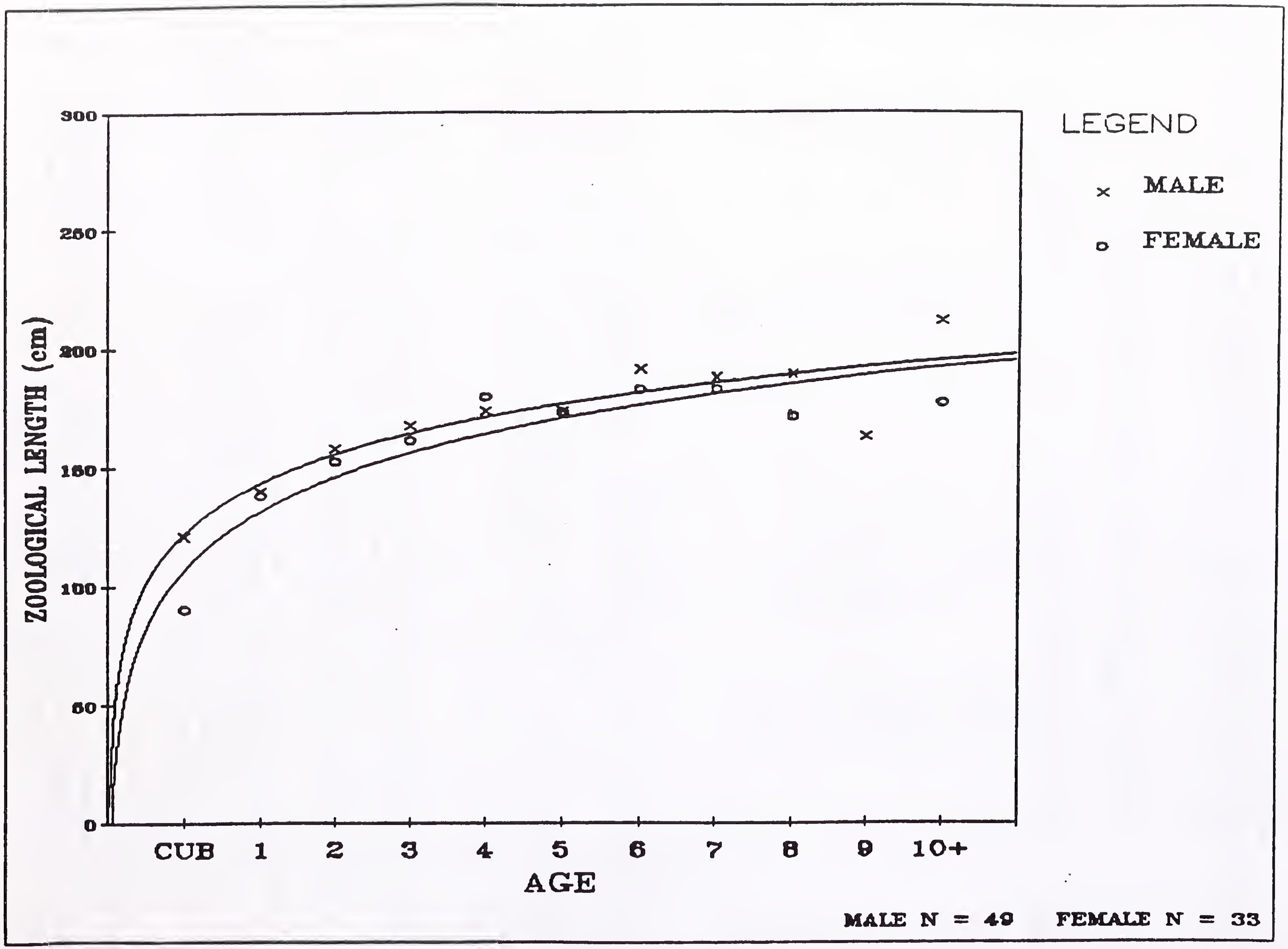


Figure 8. Grizzly bear mean zoological length.

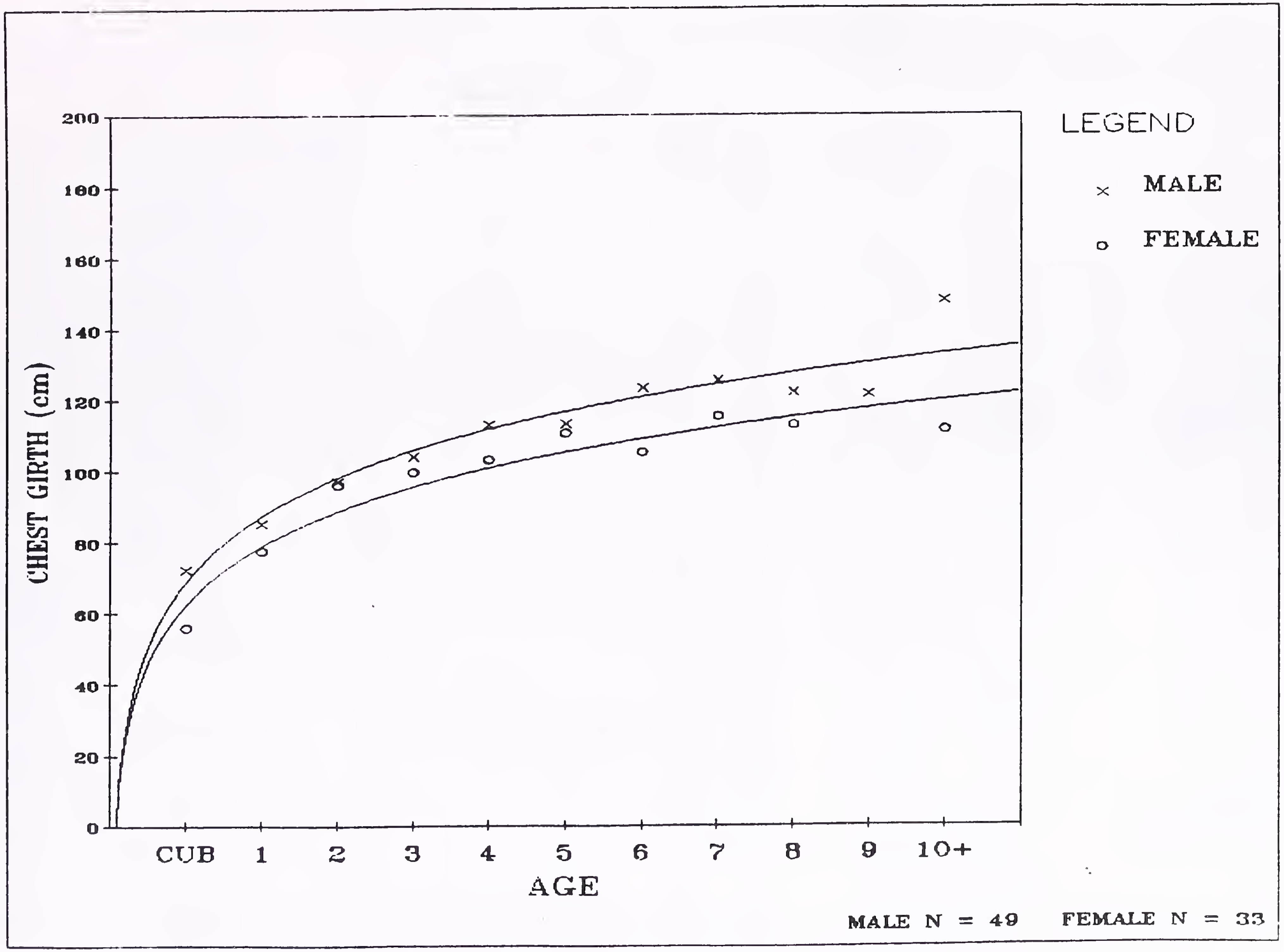


Figure 9. Grizzly bear mean chest girth.

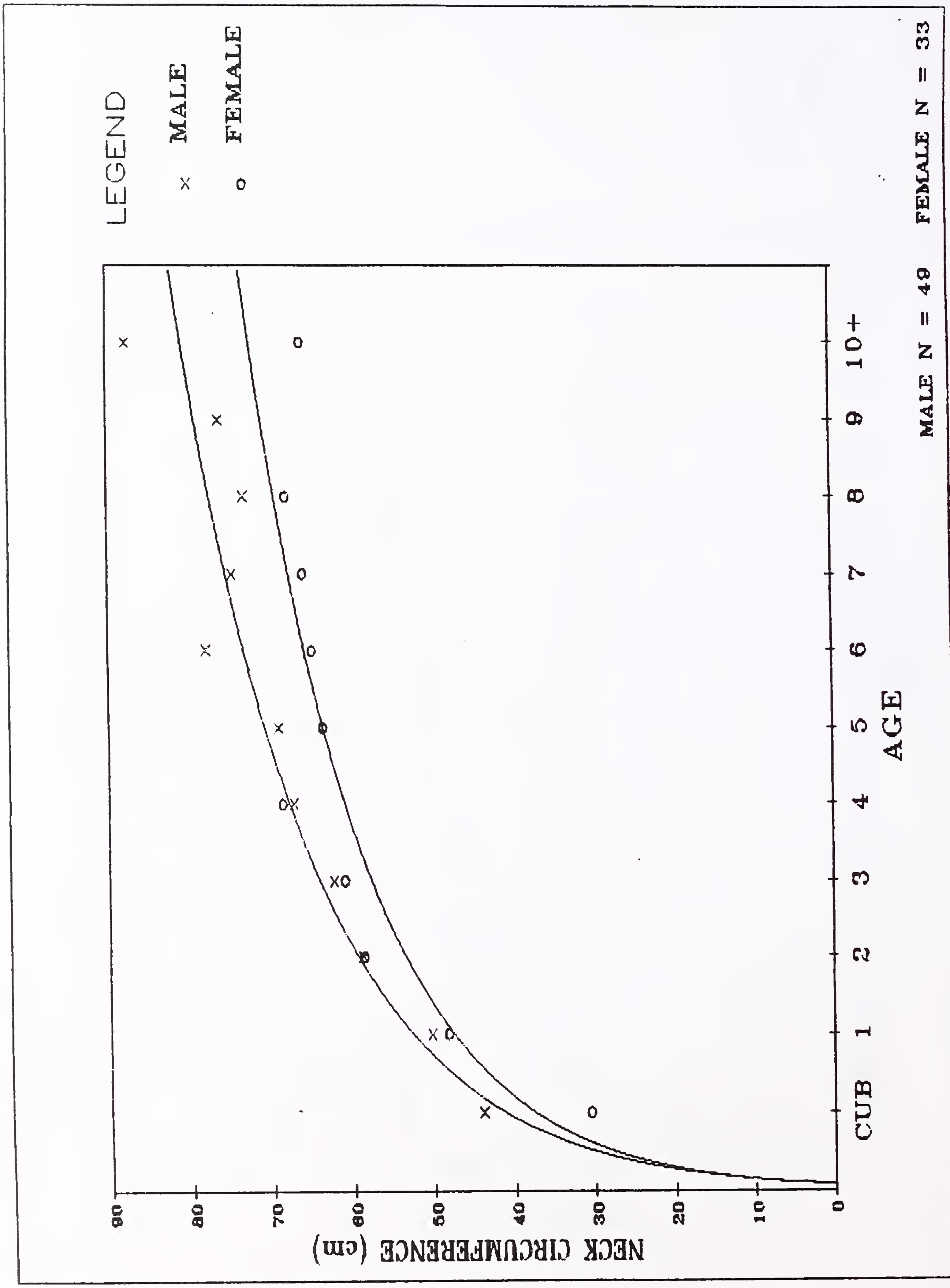


Figure 10. Grizzly bear mean neck circumference.

Pelage color of bears captured on the Rocky Mountain East Front was highly variable. Coats ranged from almost entirely blond with slightly darker leggings to almost completely black with light silvertipping over the hump. The description of coat color was difficult to quantify, however, there did appear to be a darkening trend in coat color with age.

Grizzly Bear Distribution

Distribution of grizzly bears was determined from 4,138 observations, including radio locations, gathered from 1976-1987. Eighty percent (3,306) of the observations were collected north of the Sun River (Table 9) and 20% (832) of the observations were collected south of the Sun River (Table 10). The percent of observations collected for spring, summer and fall was 33.6, 38.7, and 27.7 respectively. Studies from 1976-79 by Schallenberger and Jonkel (1977, 1978, and 1979) account for 23.8% (978) of the total observations recorded from the study area.

Table 9. The number of observations plotted on the Sun River North[1] overall and seasonal distribution maps, 1976-87.

Period	Spring	Summer	Fall	Total
1976-79[2]	148	345	205	698
1980	50	83	62	195
1981	186	128	89	403
1982	173	200	148	521
1983	183	189	165	537
1984	84	149	94	327
1985	116	87	71	274
1986	61	92	64	217
1987	66	36	32	134
TOTAL	1,067	1,309	930	3,306

[1] North of Township 21-22 line.
[2] Reported in Schallenberger and Jonkel, 1980.

Distribution maps indicate that grizzly bears were present in each of the six BMU's on the Rocky Mountain Front (Figures 11 and 12). The concentration of research effort in some areas and the reduced effort in others confounded the results. The study area was large and back country areas received less field effort. Much of the information in these regions reflects a low intensity of field work, rather than the true distribution of grizzly bears. Restricted access to some private land also prohibited field work in areas which deserve attention. The Deep Creek area may receive considerable grizzly bear use, however, observation data are limited in this area. Another area deserving more attention is the Birch Creek-Lower Badger area west of Heart Butte.

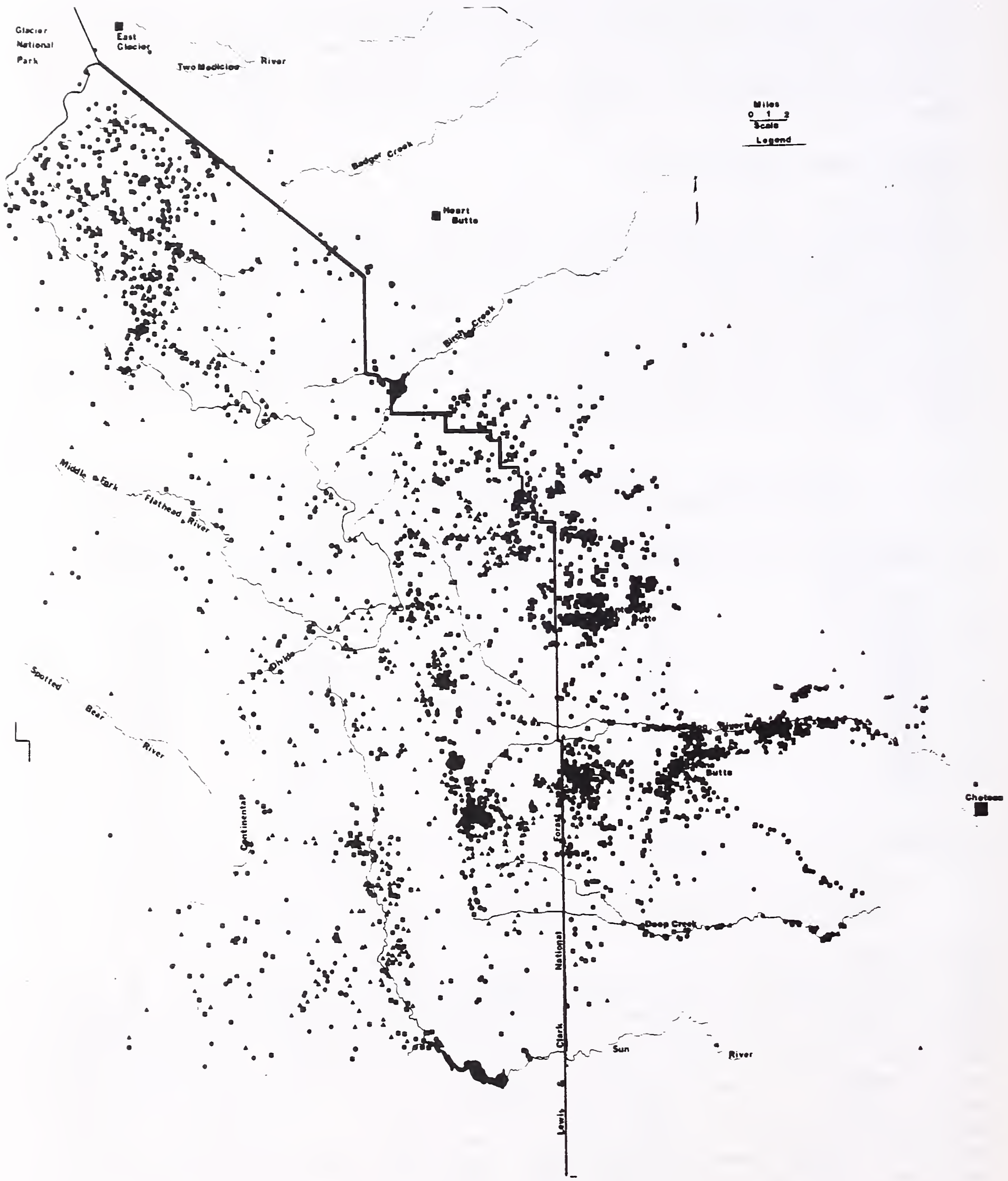


Figure 11. Distribution of 3,306 grizzly bear observations, 1976-87, north of the Sun River.

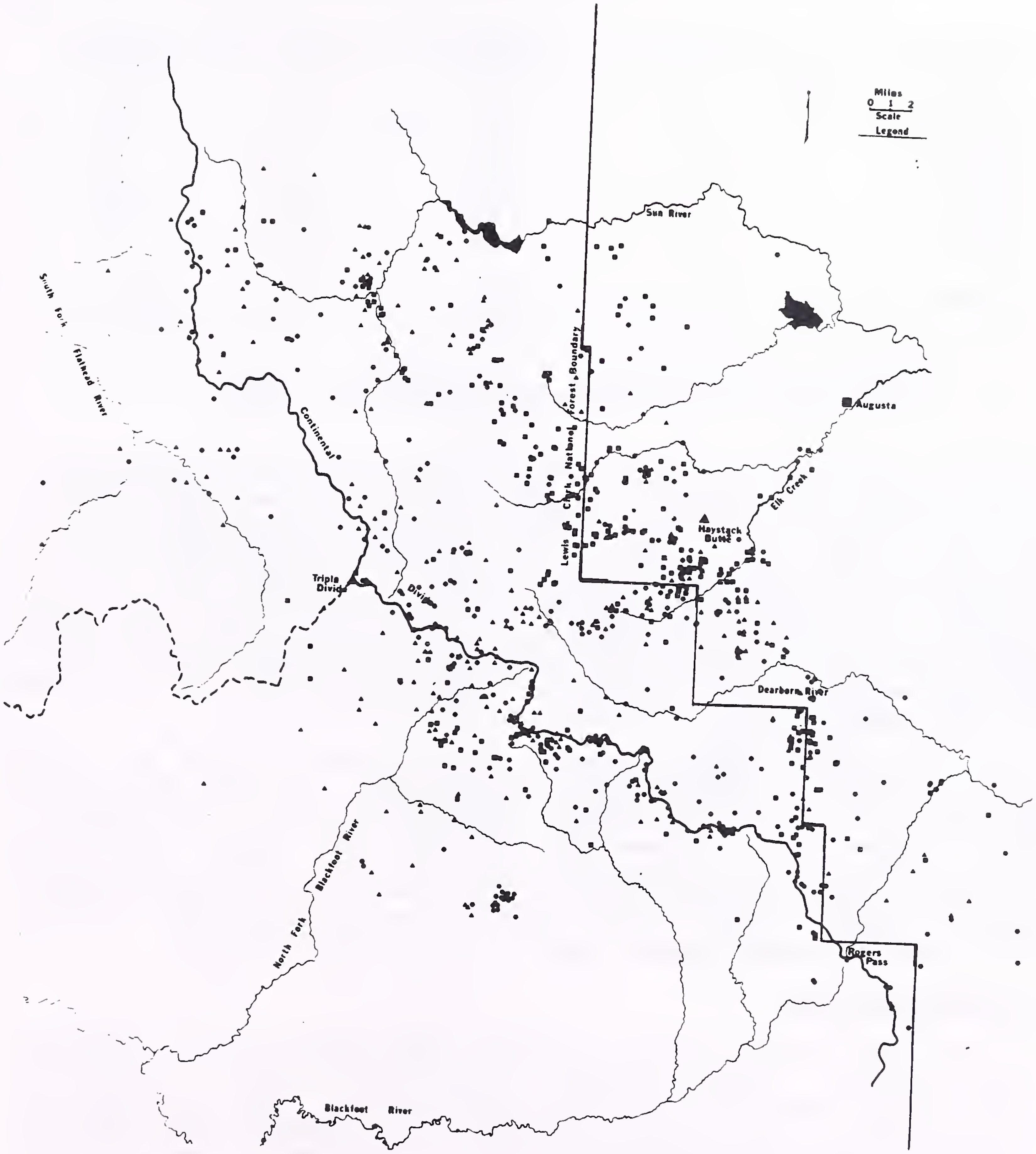


Figure 12. Distribution of 832 grizzly bear observations, 1976-87 south of the Sun River.

Table 10. The number of observations plotted on the Sun River South[1] overall and seasonal distribution maps, 1976-87.

Period	Spring	Summer	Fall	Total
1976-79[2]	87	93	109	289
1980-83	57	37	6	100
1984	23	29	31	83
1985	71	55	38	164
1986	67	48	20	135
1987	20	29	12	61
TOTAL	325	291	216	832

[1] South of township 21-22 line.
[2] Reported in Schallenberger and Jonkel, 1980.

Seasonal distribution maps revealed the importance of river valley, creek bottom and foothills habitat to grizzly bears during the spring (Figures 13 and 14). Schallenberger and Jonkel (1980), Servheen (1981), and Jonkel (1980) reported the importance of low elevation wet sites and creek bottoms to grizzly bears in the spring. The concentration of grizzly bears along these foothills, creeks and river bottoms appears to be related to the early snow melt from these sites and the phenology of important bear foods. Grizzly bears distribute themselves more evenly throughout the area during summer and fall (Figures 15, 16, 17 and 18).

Bear distribution appeared to be more clustered south of Birch Creek. Bears were concentrated on seasonal resources which were clustered in their distribution. These include wet or mesic areas, berry fields, alpine slopes, and whitebark pine forests. North of Birch Creek in the Badger-Two Medicine area bears were more uniformly distributed as were the food resources. Sidehill Parks, mesic timber stands and timbered shrubfields were evenly distributed throughout the region north of Birch Creek.

Observation Data

Grizzly observation reports included sightings as well as physical sign of bears. Sign evidence was primarily tracks, scats, and digs. Other types included hair, marking posts, dens, and evidence at depredation sites. The observation data discussed here does not include visual observations or radio locations of marked bears while on radio relocation flights.

From 1980-87, 945 grizzly bear observations were reported. The types of observations included; 341 (36.1%) sightings, 308 (32.6%) tracks, 230 (24.3%) scats, 40 (4.2%) digs, and 26 (2.8%) other.

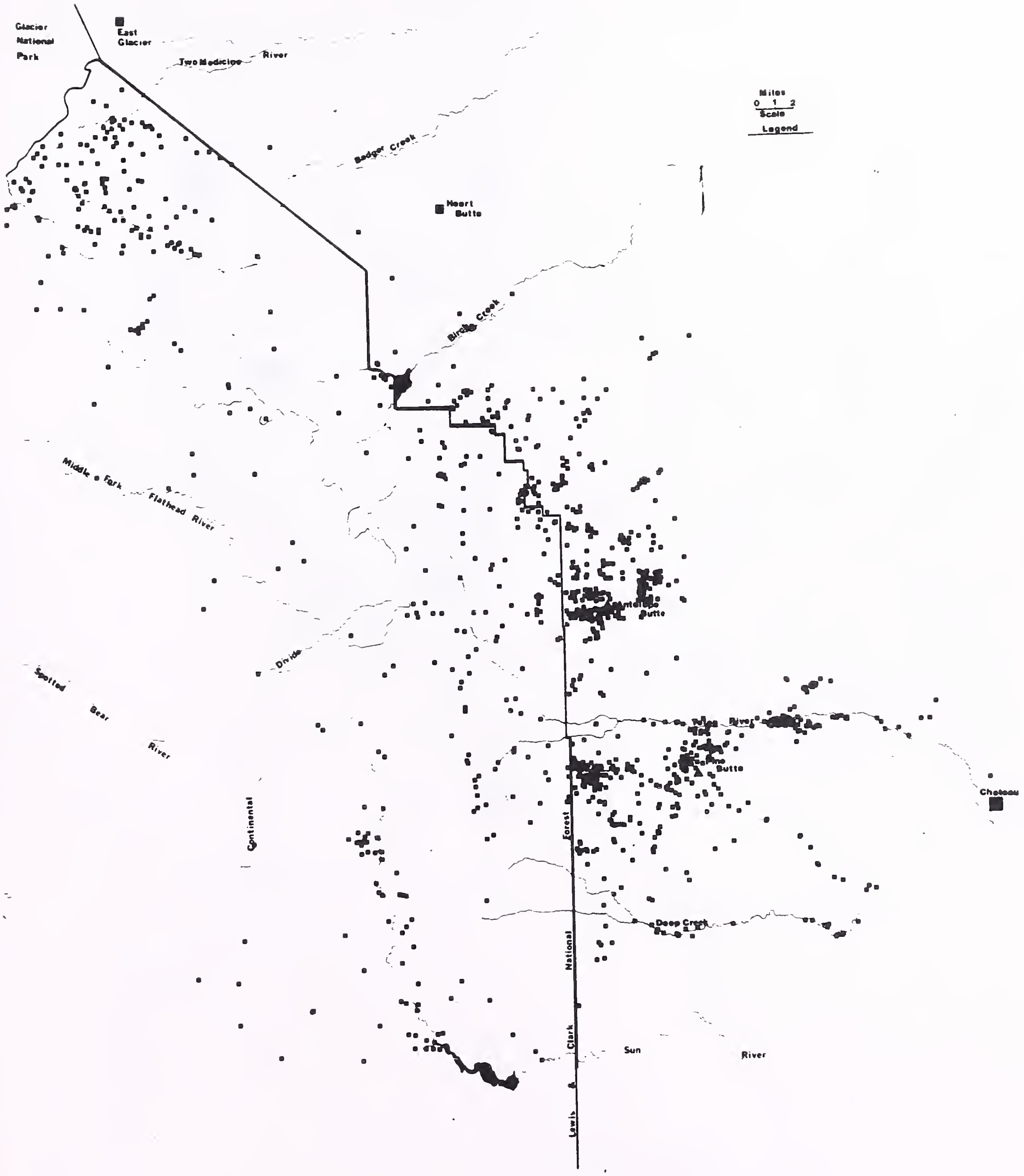


Figure 13. Distribution of 1,067 grizzly bear observations, 1976-87, north of the Sun River.

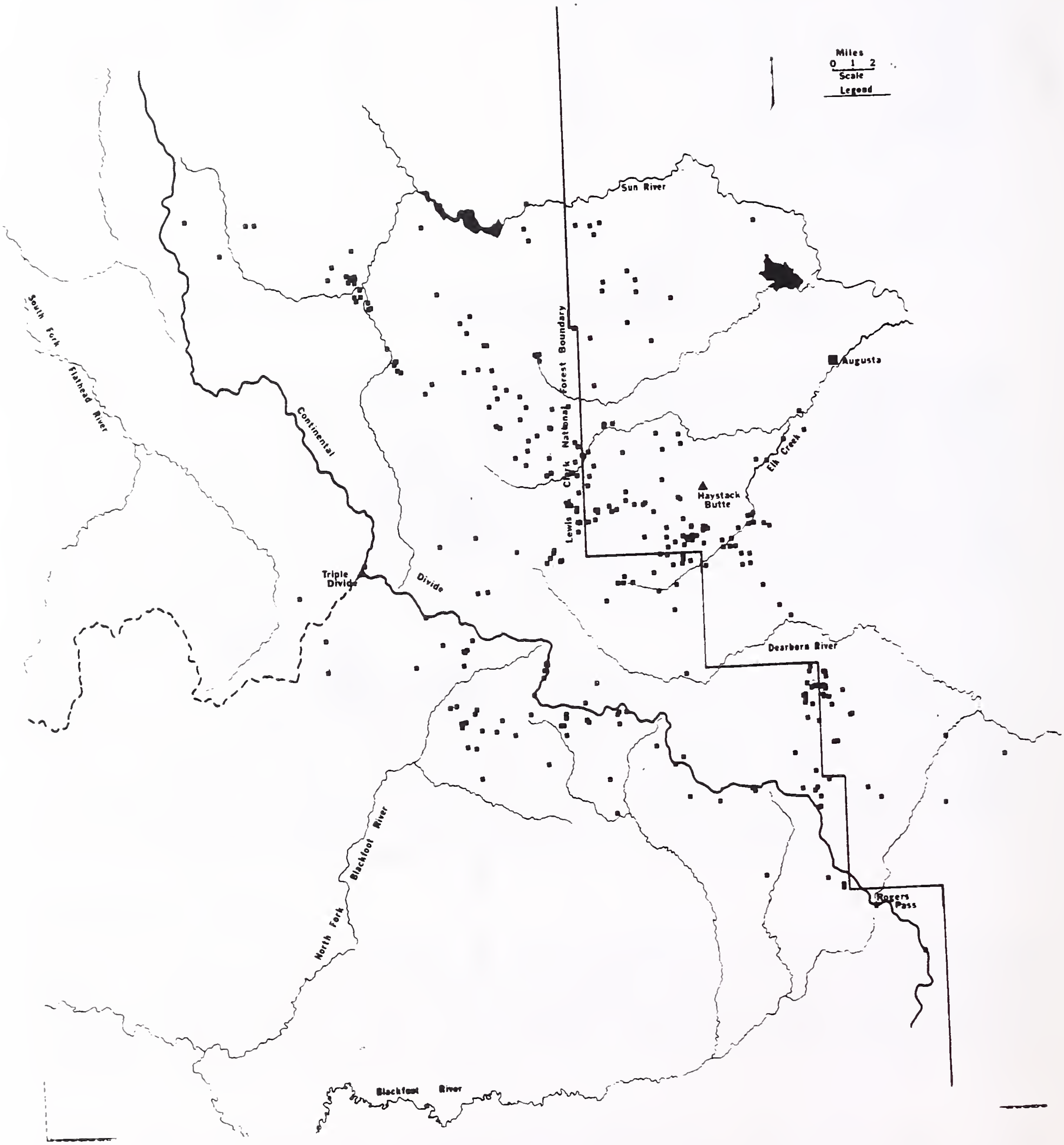


Figure 14. Distribution of 325 grizzly bear observations, 1976-87, south of the Sun River.

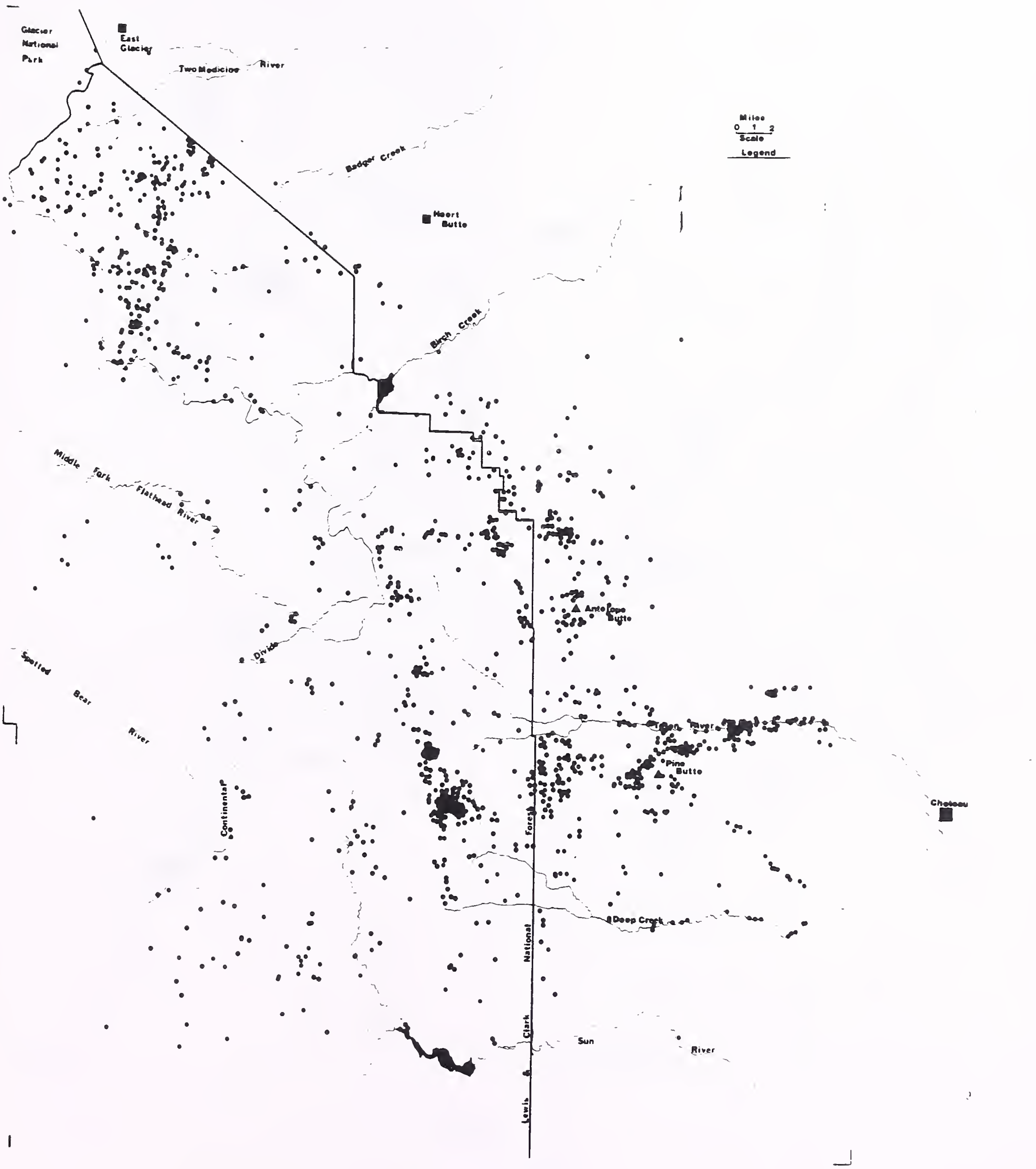


Figure 15. Distribution of 1,309 grizzly bear observations, 1976-87, north of the Sun River.

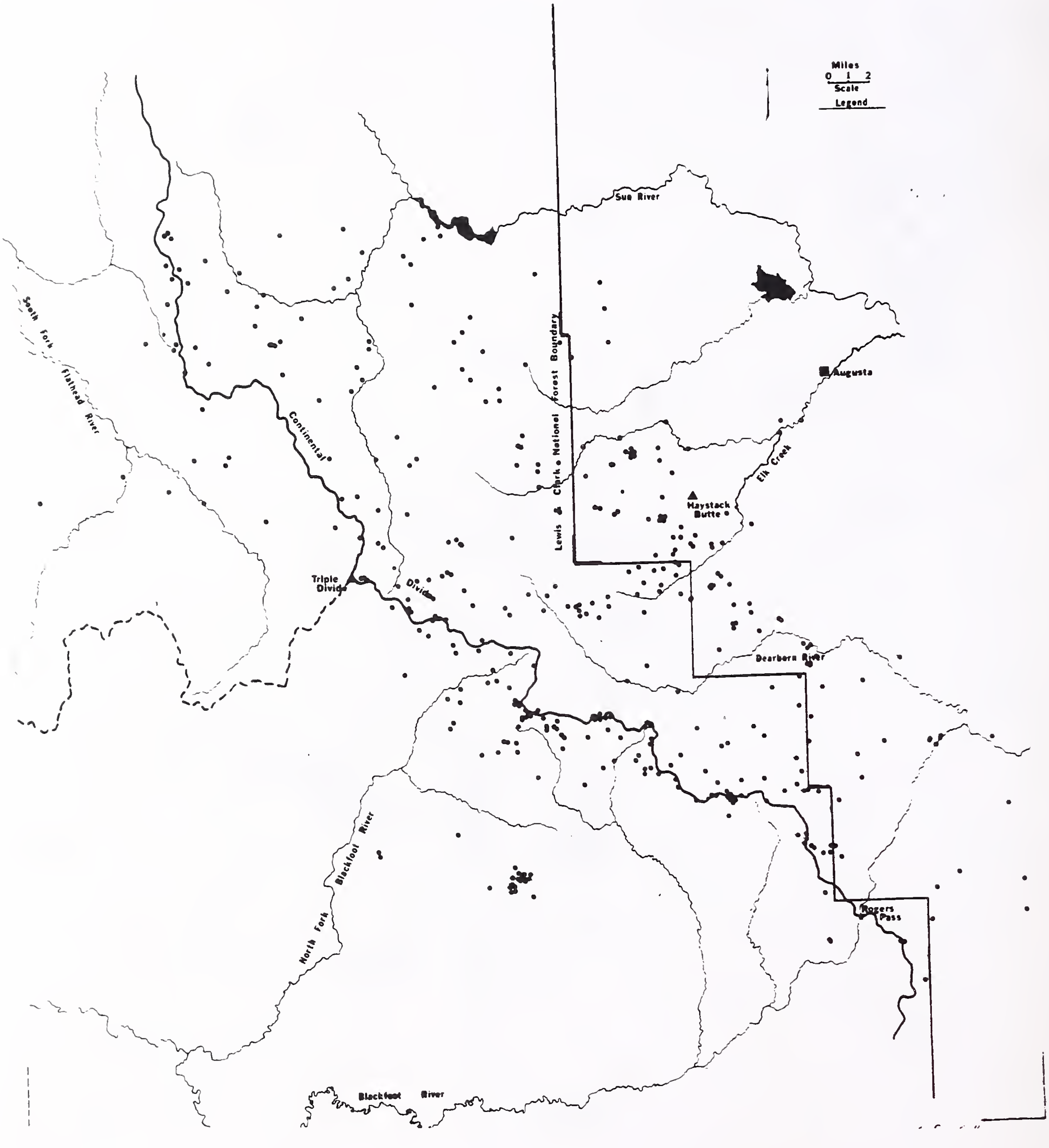


Figure 16. Distribution of 291 grizzly bear observations, 1976-87, south of the Sun River.

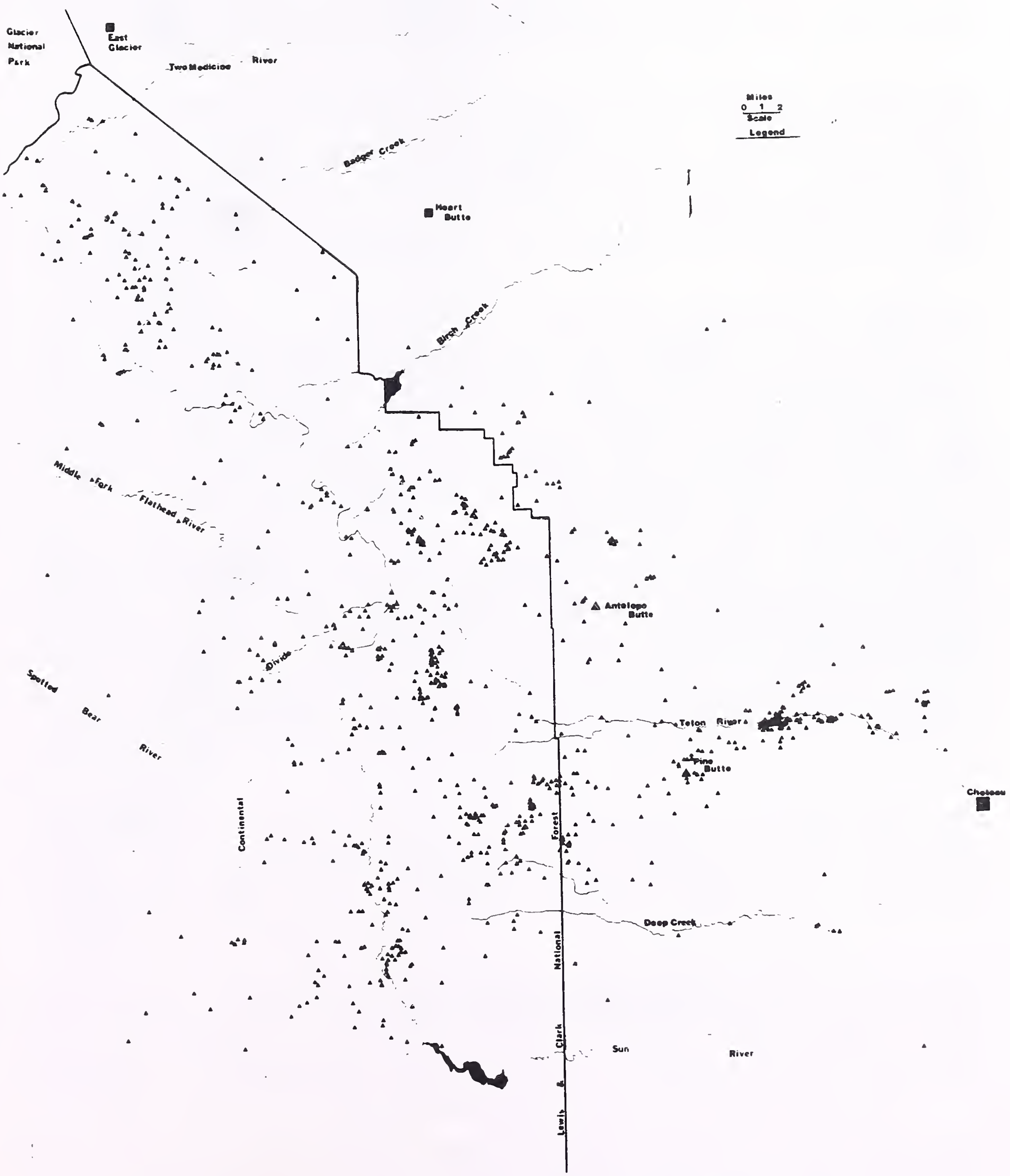


Figure 17. Distribution of 930 grizzly bear observations, 1976-87, north of the Sun River.

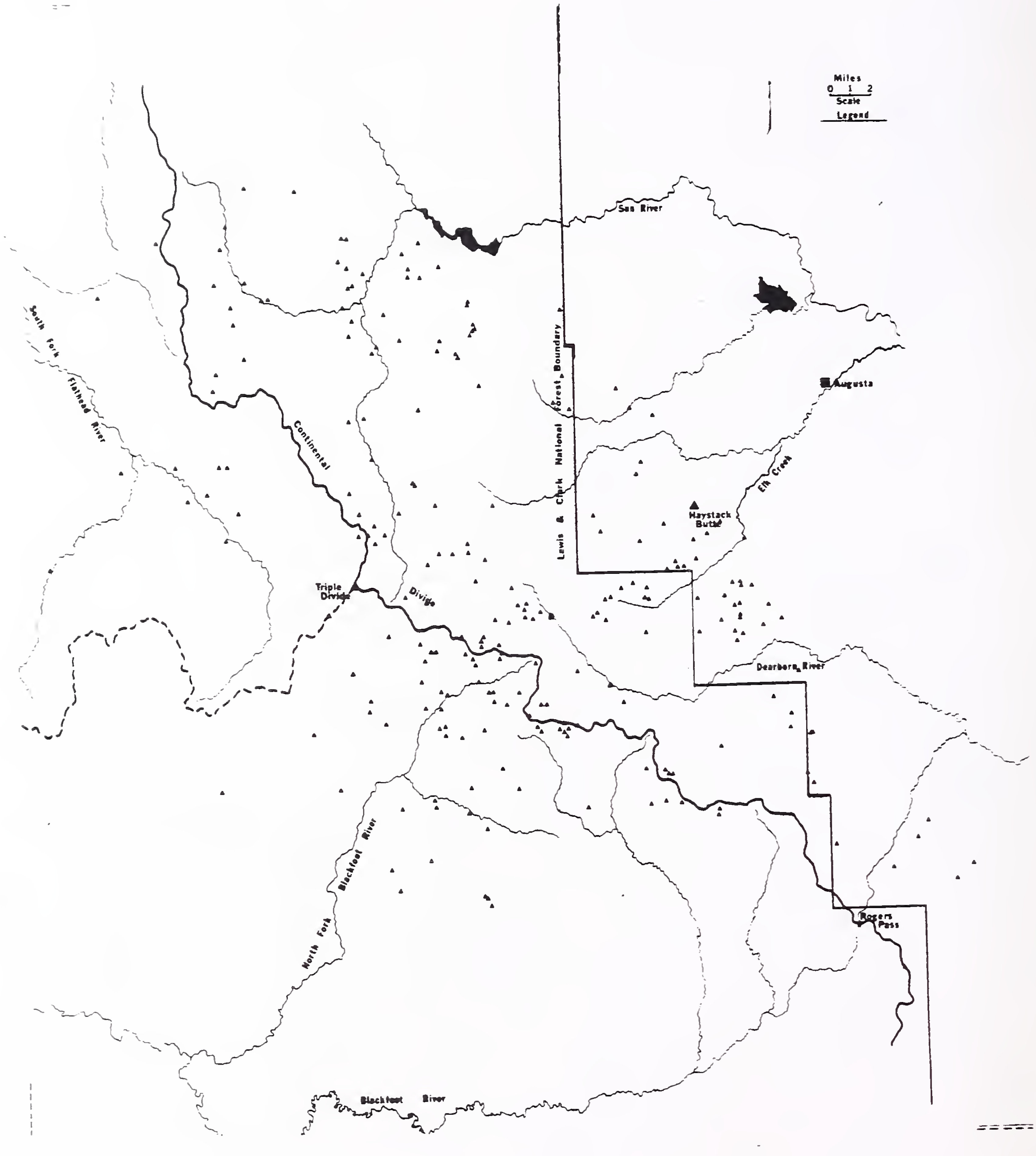


Figure 18. Distribution of 216 grizzly bear observations, 1976-87, south of the Sun River.

Observation records came from lands administered by four national forests, the Blackfoot Indian Reservation, Bureau of Land Management, Montana Department of Fish, Wildlife, and Parks, The Nature Conservancy, and private landowners. The largest proportion (84.5%) of the observations were gathered on the Lewis and Clark Forest and private lands adjacent to the forest.

The proportion of observations gathered during spring, summer and fall was 37.6, 36.7, and 25.7%, respectively. The highest number of sightings were recorded during the summer when the largest number of potential observers were afield either working or recreating (Figure 19). Tracks were more commonly reported in spring and fall than during the summer. It is probably at this time that higher precipitation and the soil moisture conditions increased the visibility of tracks.

We categorized the dates of each observation into weekly periods and looked for peaks or trends in data collection in order to identify the times when bears would be most observable (Figure 20). Bears or sign of bears were observed from the second week of March until the last week of November. One record of an observation was collected from the month of February. Peaks in the data were present in late May during the height of the breeding season and in late summer-early fall when the berry season is at its peak.

The largest percentage (65.6%) of observation data was collected while traveling by foot or horseback (Table 11). The largest number of sightings were of unmarked bears recorded while in aircraft during radio relocation flights. The fewest numbers of sightings were recorded while in vehicles indicating that bears are least likely to be observed using this mode of transportation. Tracks, scats, digs and other evidence of bears were more likely to be observed while traveling on foot or horseback. The types of grizzly sign recorded appeared to be related to the mode of transportation through grizzly range.

The duration was recorded for 187 sightings. Duration was categorized as brief (< 2 min.), substantial (2-10 min.), or long (> 10 min.). Sightings categorized as long duration were largely made while traveling by vehicle, foot, or horseback (Table 12). Seventy percent of the sightings were of bears seen from two minutes to over 10 minutes.

The distance from the observer to the bear sighted was recorded in 181 records. These distances were categorized into 0-10 m, 11-50m, 51-100m, 101-200m, 201-500m, and >500 m classes. Sixty-two percent of the sightings were within 100 m. distance (Figure 21). The percent of sightings within 100 m. obtained from vehicles, aircraft, foot, and horseback were 56.6, 74.0, 62.5, and 59.6.

The time of a sighting was recorded in 239 records. Sightings were categorized into morning, midday, evening, and night time periods.

Table 11. The number/percent of each type of observations recorded using different modes of travel, 1980-87.

	Visual	Track	Scat	Dig	Other
Vehicle	33/24.3	43/14.0	38/16.5	2/ 5.0	3/11.5
Aircraft	104/30.5	12/ 3.9	0/ 0.0	6/15.0	5/19.2
Foot	72/21.1	30/26.0	97/42.2	24/60.0	9/34.6
Horse	65/19.1	167/54.2	89/38.7	3/20.0	9/34.6
TOTAL	341/36.1	308/32.6	230/24.3	40/4.2	26/ 2.8

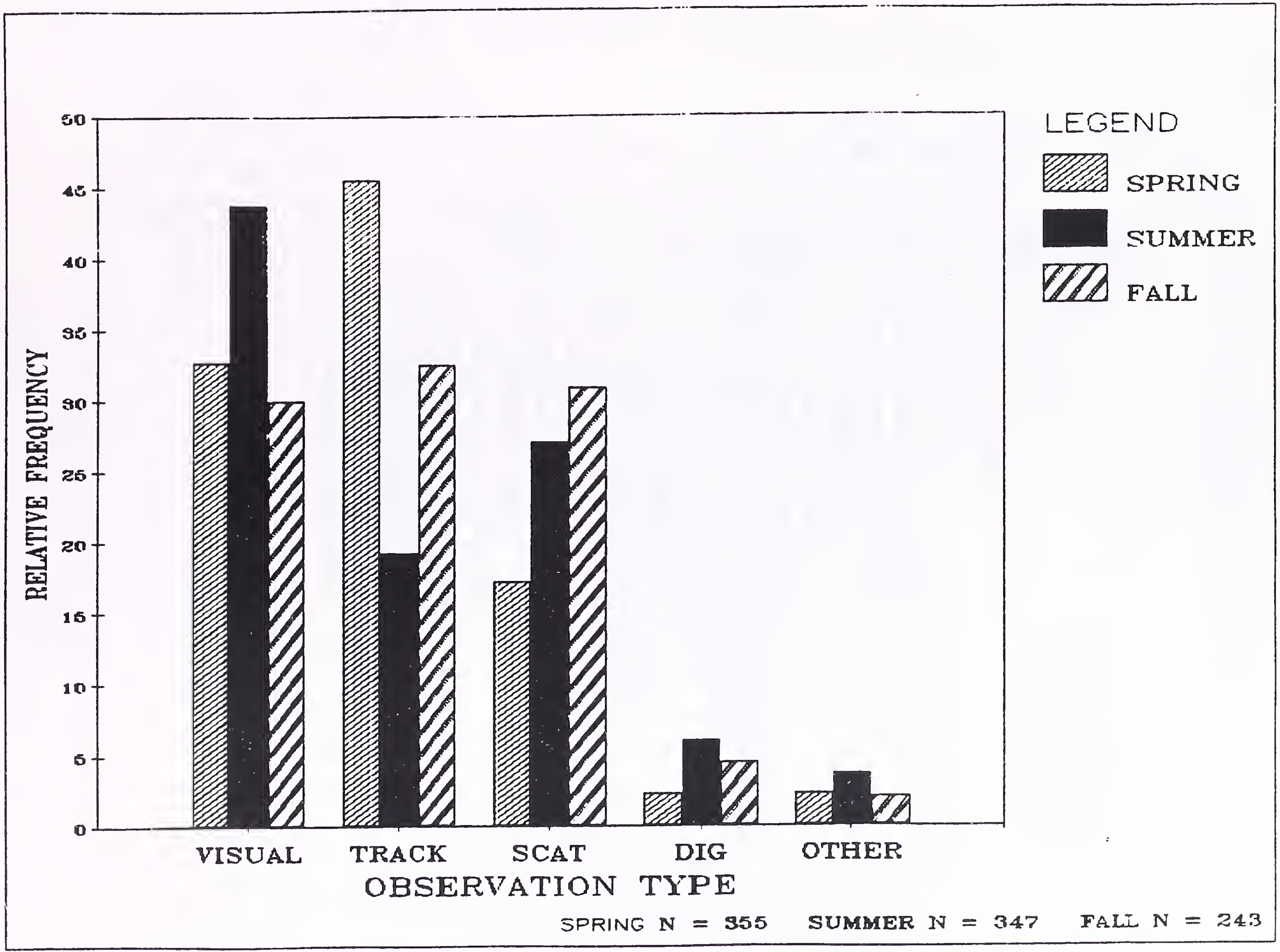
Table 12. The duration of visual sightings of bears by the type of travel, 1980-87.

Duration	Frequency and percent										
	Vehicle	%	Air craft	%	Foot	%	Horse back	%	Unk.	%	TOTAL
Brief	13	22.4	15	25.9	13	22.4	17	29.3	0	0	58
Subst.	16	20.8	36	46.8	11	14.3	14	18.2	0	0	77
Long	11	21.2	3	05.6	18	34.6	11	21.2	4	02.7	52

The morning time period recorded the most sightings (Figure 22). These data are biased toward the morning period because this was the general time that all radio relocation flights were made.

In 144 sighting records the behavioral response of the bear toward the observer was recorded. Nine categories were developed to describe the general type of response by grizzly bears to the observer (Table 13). Responses which could be classified as aggressive in nature constituted only 2.1% of the sightings where behavioral response was recorded. None of the aggressive interactions reported involved human injury and all were mostly threat postures and bluff charges Flight or other avoidance behavior was recorded in 65.3% of the incidences reported. Passive or neutral responses were recorded in 29.1% of the sightings.

The number of bears involved in each sighting ranged from one to seven and averaged 1.6 bears. Over 75% of the sightings were of one or two bears (Table 14). Adults were reported in 50.4% of the sightings and subadults in 26.1%. Yearlings or cubs were observed in 25.5% of the sightings. Twenty six adult females were observed with 57 yearlings for an yearling to adult ratio of 2.19. Forty-four adults were observed accompanied with 88 cubs for a cub/adult ratio of 2.0.



SPRING N = 355   SUMMER N = 347   FALL N = 243

Figure 19. Grizzly bear observations.

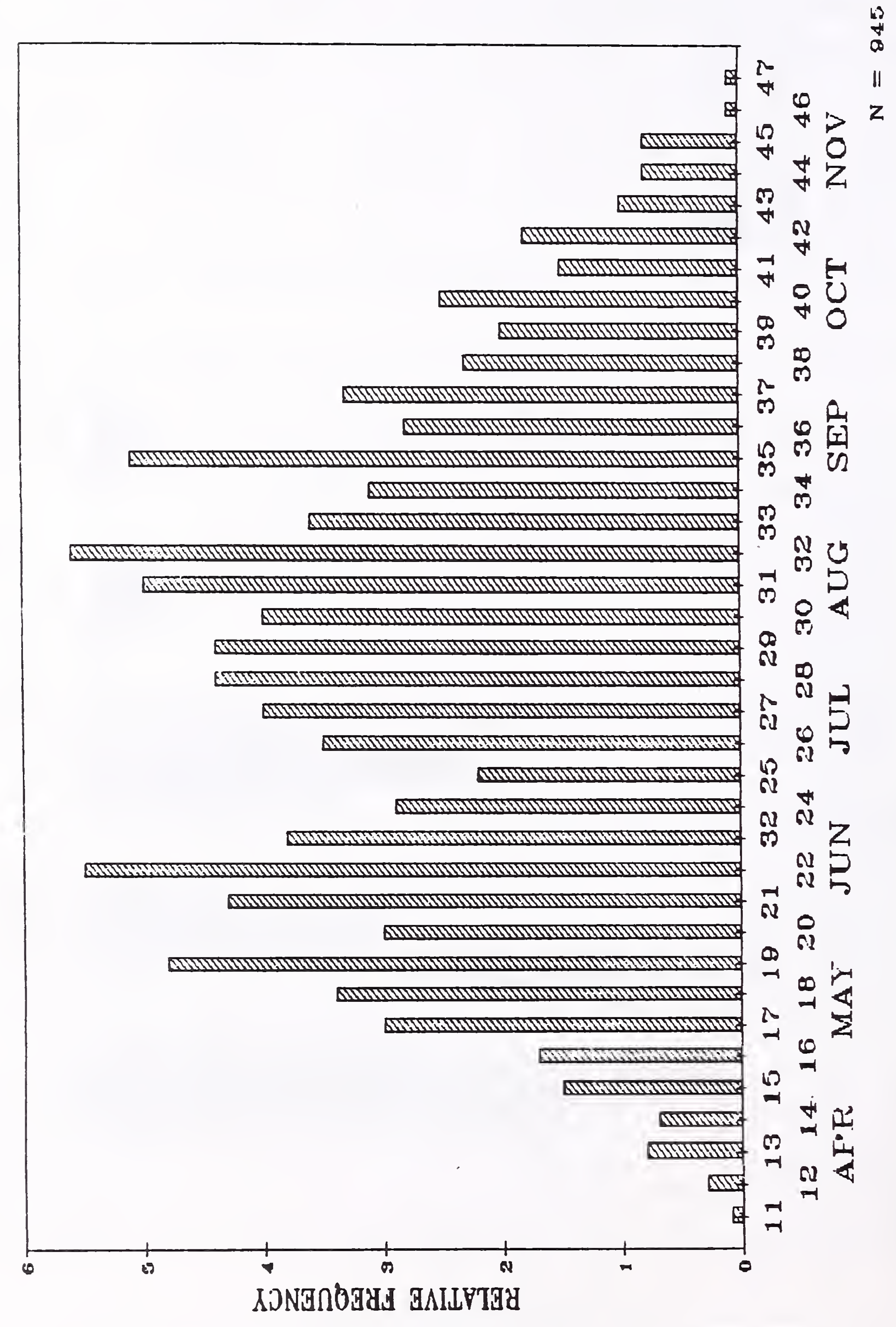


Figure 20. Grizzly bear observations by week.

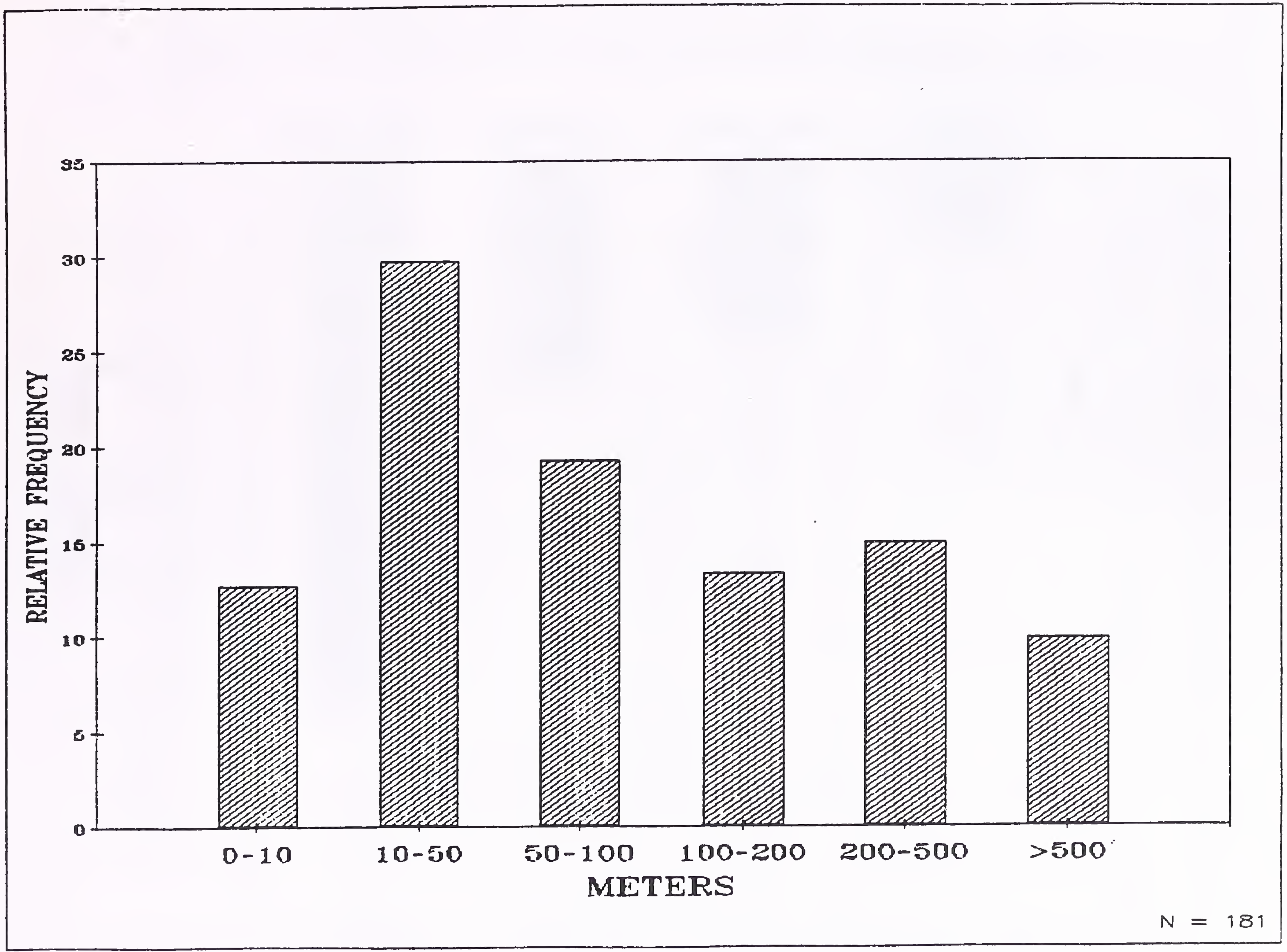


Figure 21. Grizzly bear visual observations distance from observer.

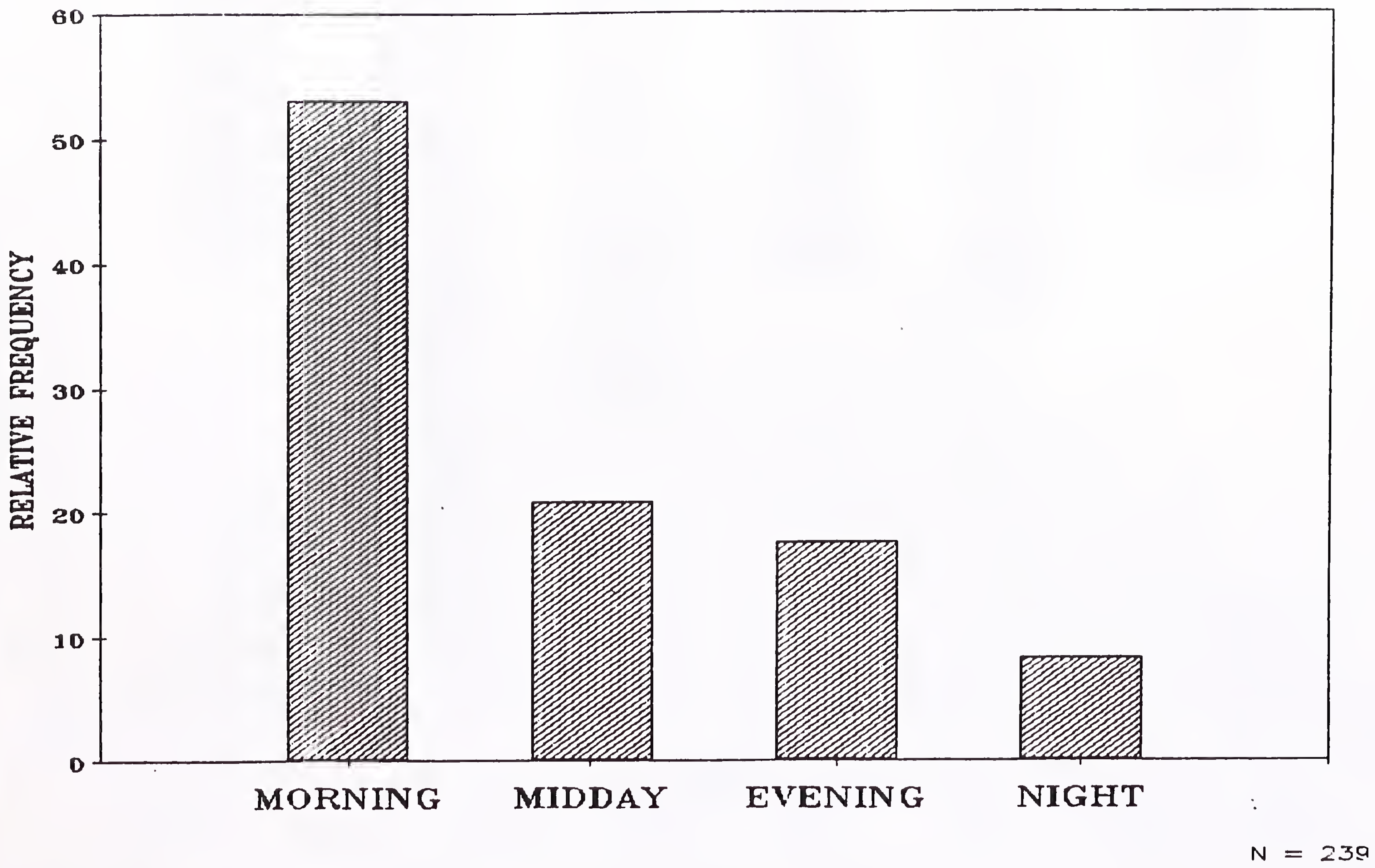


Figure 22. Grizzly bear visual observations by time of day.

Table 13. Behavioral response of grizzly bears to observers reporting a sighting on the Rocky Mountain Front, 1980-87.

Behavior	Frequency	Percent
Ignore (little acknowledgement)	38	26.4
Alert:		
Then resume activity	4	2.8
Then flee	24	16.7
Then approach (no aggression)	3	2.1
Then approach (aggressively)	3	2.1
Then maintain alert	2	1.4
Flight	53	36.8
Other avoidance behavior	17	11.8

Table 14. The number and percent of bears sighted in each visual observation on the Rocky Mountain Front, 1980-87.

Number of Bears	Frequency	Percent
1	182	53.4
2	76	22.3
3	60	17.6
4	19	5.6
5	3	0.9
7	1	0.3

Approximately 75% of all the observations were recorded within 100 m. of cover (Table 15). Bears observed at greater distances were generally travelling or accessing carrion available at sites away from cover.

Table 15. Distance to cover of grizzly bear observations from the Rocky Mountain Front, 1980-87.

Distance	Number of observations					
category	Visual	Track	Scat	Dig	Other	Total
< 100 m.	222	258	175	31	20	706
100-500 m.	38	20	14	5	1	78
> 500 m.	40	4	8	3	1	56

Bear observations were recorded within each of the 16 habitat components used by radio monitored grizzly bears (Figure 23). Generally grizzly bear habitat use as determined from observations was similar to that from radio location data with the exception that open components were more commonly over represented while closed canopy habitats were under represented in the sample.

The specific activities of grizzly bears, in 550 observations were recorded during the study (Table 16). In 186 records (33.8%) non-feeding activities were reported while in 364 cases (66.2%) bears activities were classed as feeding. Bears were reported feeding on carrion, grazing, digging roots, digging pine nuts, feeding on berries, or feeding on anthropogenic food sources in 90% of the total records involving feeding activity.

Table 16. Grizzly bear activities recorded by observations from the Rocky Mountain Front, 1980-87.

Activity	Number of Observations			
	Spring	Summer	Fall	Total
Feeding:				
General	1	10	4	15
Carrion	59	13	29	101
Grazing	17	10	2	29
Root Digging	13	88	20	121
Pine Nuts	2	4	14	20
Small Mammals	2	1	3	6
Insects	1	10	6	17
Berries	1	15	8	24
Stripping Bark	0	1	0	1
*Anthropogenic	8	8	17	33
Non-feeding:				
General	9	7	3	19
Bedded	6	7	6	19
Travelling	51	33	31	115
Courting	16	1	0	17
Denning	1	0	2	3
Bathing	0	1	1	2
Playing	2	9	0	11

* Anthropogenic food sources other than livestock carrion.

The most common non-feeding activity reported in observations was travelling. There is a conspicuous absence of observations of bedded bears in the data. This is in great contrast to the large number of radio locations in which bears were in beds.

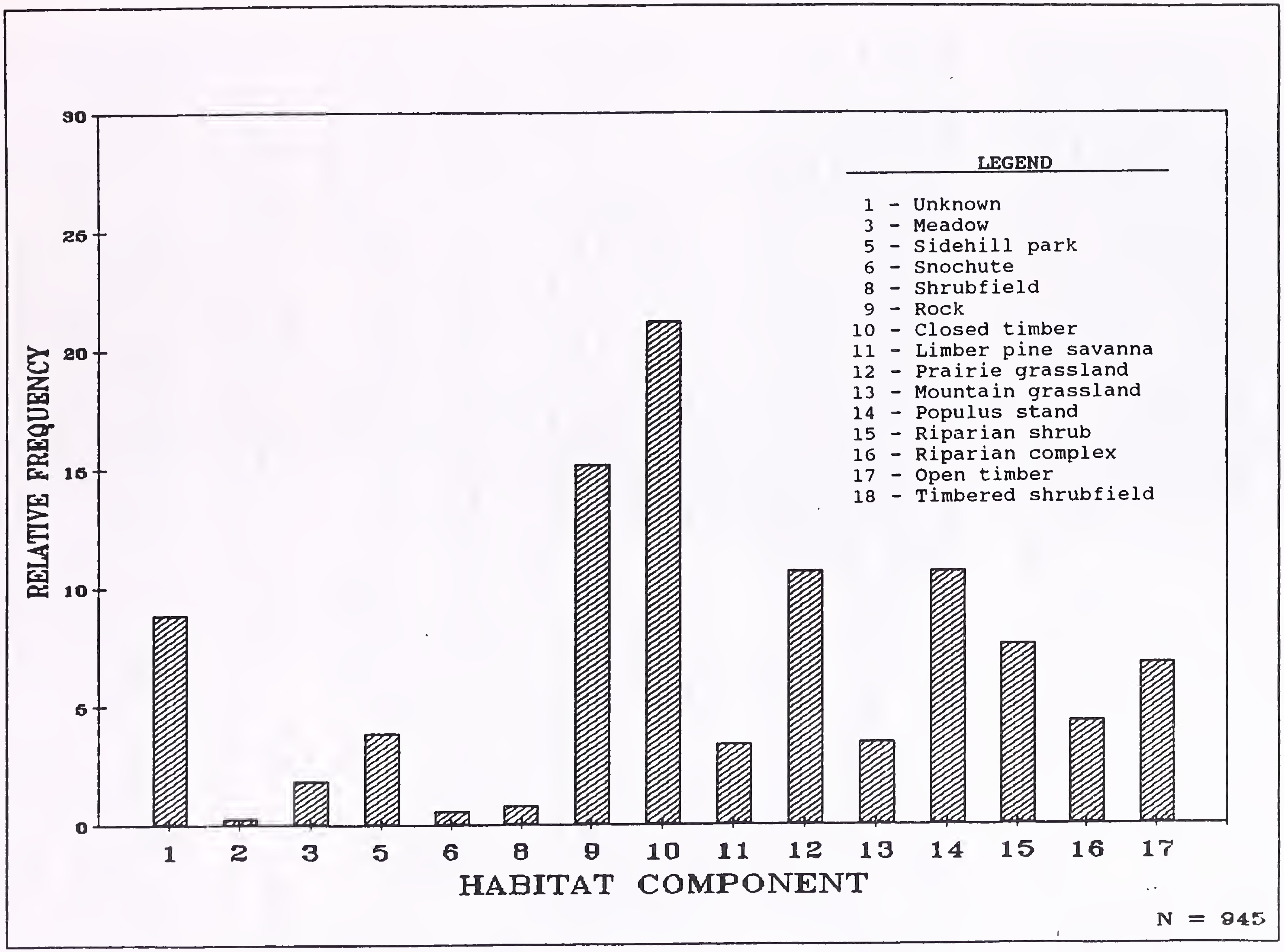


Figure 23. Grizzly bear observation.

Home Range of Grizzly Bears

Annual and composite home ranges were developed for bears which were relocated at least nineteen times and with locations within each of the seasons. We calculated minimum convex polygons and modified minimum home ranges for each bear. Sixty-one minimum annual home ranges were calculated from 28 individual bears during the study. Fifty-one modified minimum annual home ranges were calculated for 24 individual bears. Composite ranges were developed for 28 bears during the study. Other radio monitored bears provided insufficient data for the calculation of home ranges.

We examined the relationship between the number of fixes obtained and the size of annual minimum, annual modified minimum, and composite home ranges. Each regression of the number of locations and the size of home ranges was flat or declining with no statistical significance to the slope indicating a sufficient sample rate was used in determining home range size. The average number of locations used to calculate an annual home range was 37 (N=53). The average number of fixes used in calculating composite ranges was 38 (N=51).

Annual minimum home ranges were significantly larger ($P<0.05$) for males than females (Table 17). When sorted by sex, age, and reproductive status, subadult females had the smallest average annual minimum home range while sub-adult males had the largest (Table 18). Subadult males did not have significantly ($P<0.05$) larger annual minimum home ranges than adult males.

Table 17. Summary statistics for annual minimum home range analysis by sexes for the Rocky Mountain Front, 1977-87.

Sex	N	Average AHR (km.)	Range	S.D.
Male	18	912.2	388 - 2056	488.2
Female	43	349.6	60 - 736	155.8

One way AOV analysis indicated no difference existed between females of different ages and reproductive status, however, evidence from some individual bears indicated that females had smaller ranges when with cubs than with yearlings or without cubs (Table 19). The sample of females without cubs in this data was primarily from bears from the Badger-Two Medicine. Aune and Brannon (1986) reported smaller home ranges for bears in this BMU when compared to BMU's to the south. This sample bias probably confounded the results from the females without cubs group.

Table 18. Comparison of annual minimum home range by sex, age, and reproductive status for the Rocky Mountain Front, 1977-87.

Animal status	N	Average AHR (Km.)	Homogeneous groups
Adult female (no cubs)	11	241.8	*
Subadult female	11	325.8	*
Adult female (w/cubs)	9	374.1	**
Adult female (w/yrlgs)	12	451.7	**
Adult males	9	729.8	**
Subadult males	9	1094.7	**

Table 19. Comparison between years with cubs and without cubs of annual minimum home ranges of female bears on the Rocky Mountain Front, 1979-84.

Bear no.	N	Average AHR with cubs	N	Average AHR without cubs
466	1	59.34	1	554.34
257	2	433.00	2	409.85
220	3	343.90	3	618.58

When we compared annual home ranges of several individual adult female bears we noted bear 466 greatly restricted movements during the year she had cubs while bear 220 reduced her home range slightly and did not make movements out onto the lowlands of the front range (Figures 24 and 25). In contrast female 257 showed no tendency to alter her annual range when cubs were by her side (Figure 26). Bear 466 came from a resource rich area while bears 220 and 257 from an area with a patchwork distribution of resources. The ability to confine activities during years with cubs may depend upon habitat conditions and the distribution of food resources.

The restriction of movements for females with cubs may impact survival advantages to these litters. We could not gather enough litter survival information to confirm this hypothesis, however, in subjective terms, bears 466 and 220 were better mothers than 257. In particular 220 and 257 both exhibited two year reproductive cycles but behaviorally exhibited different mothering instincts. Perhaps 257 was living in a more demanding habitat and her behavior was modified by these conditions.

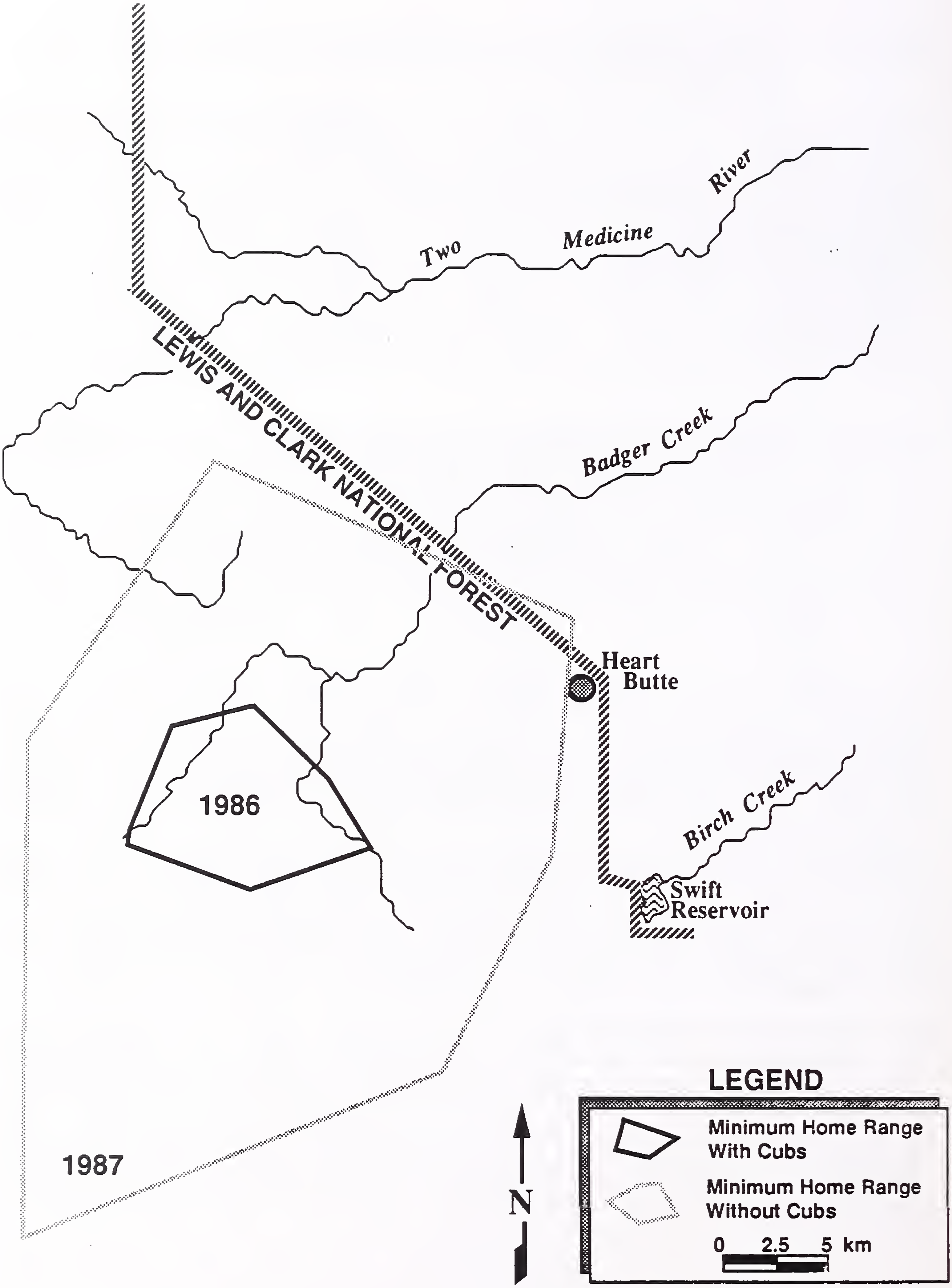


Figure 24. Annual home ranges of bear 466 with and without cubs of the year.

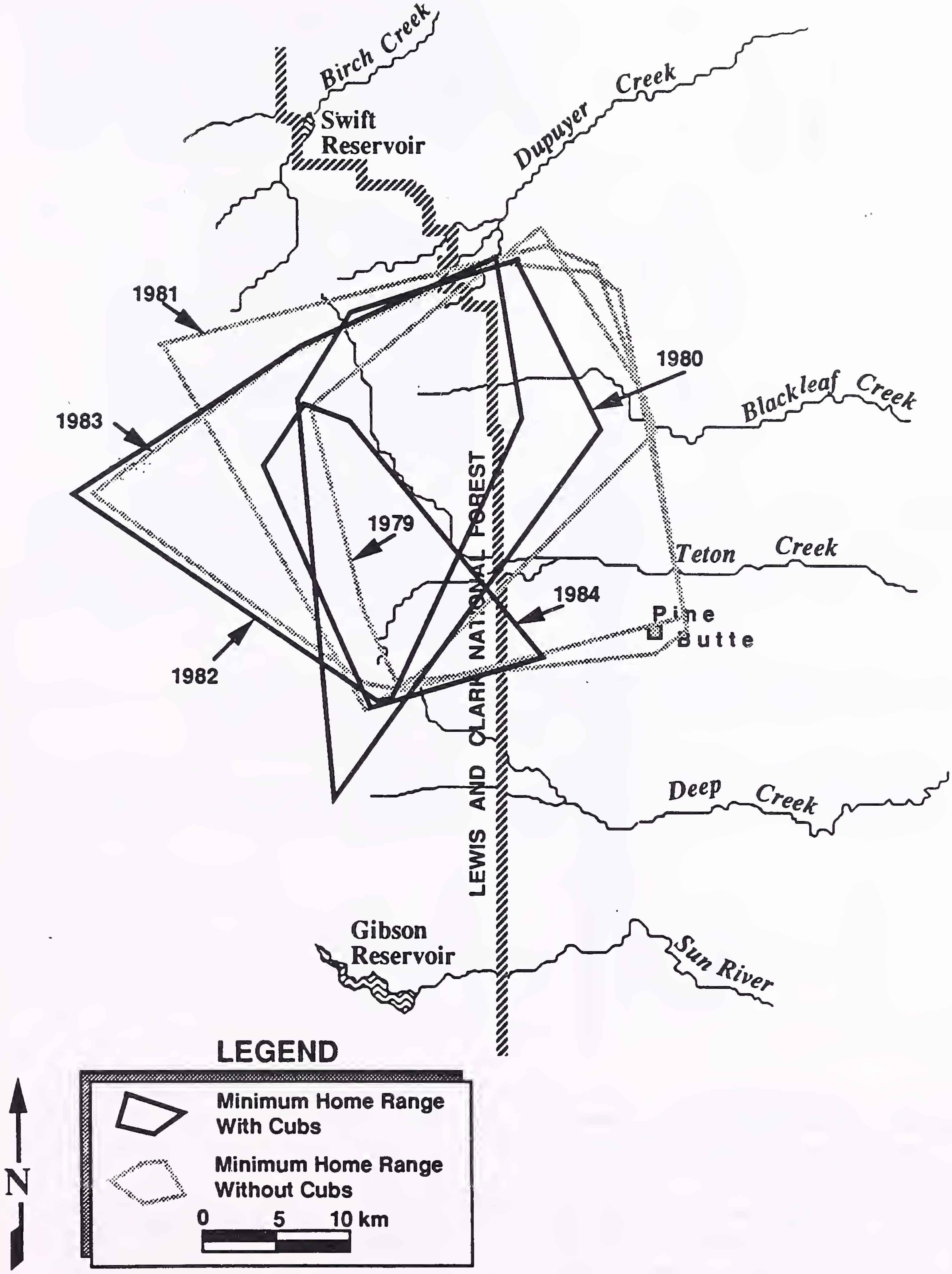


Figure 25. Annual home ranges of bear 220 with and without cubs of the year.

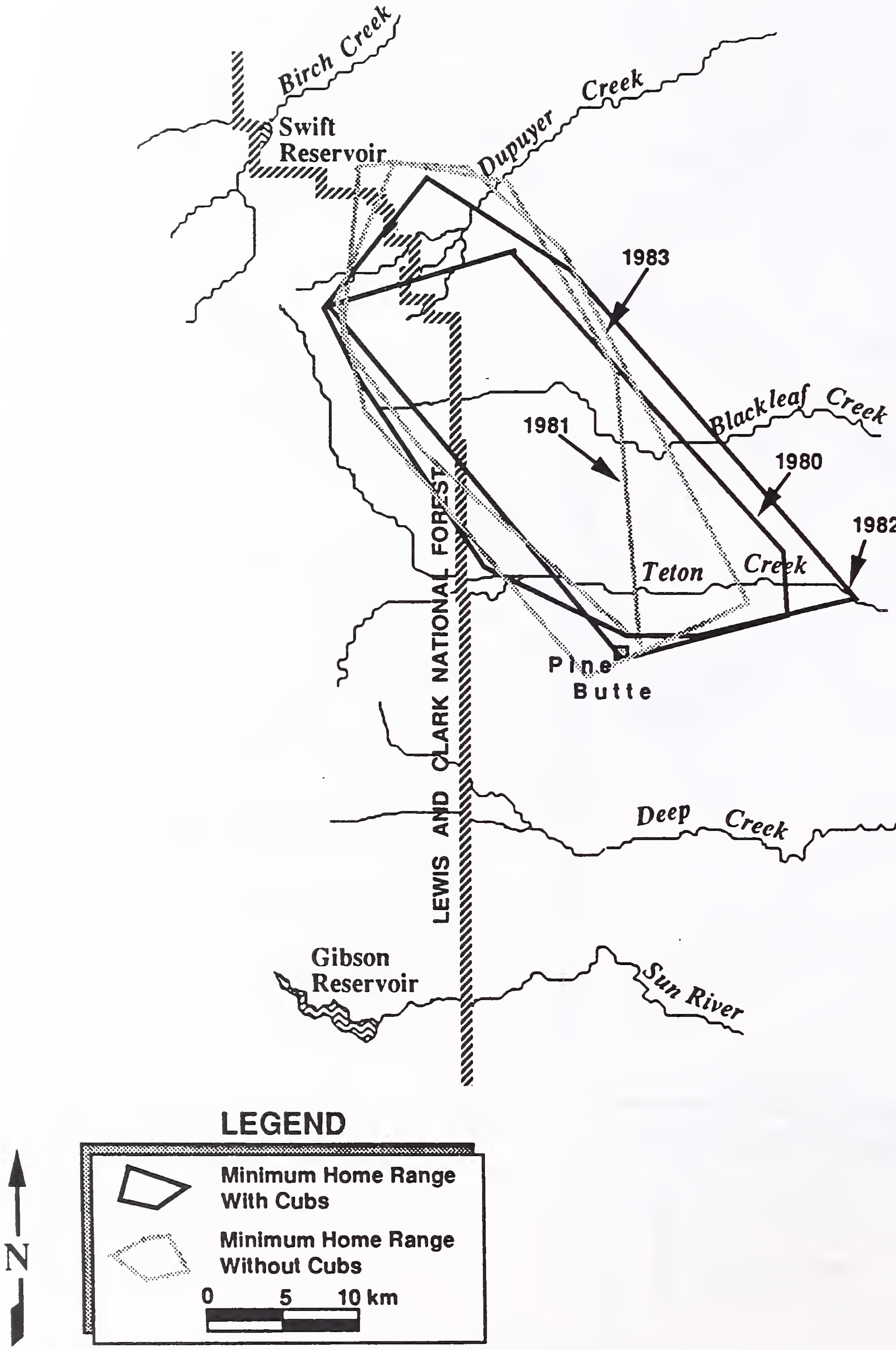


Figure 26. Annual home ranges of bear 257 with and without cubs of the year.

Annual modified minimum home ranges were significantly (P<0.05) larger for males than for females (Table 20). When sorted by sex, age and reproductive status, adult females without cubs had the smallest ranges while subadult males had the largest (Table 21). Again, the subadult males did not have significantly larger home ranges than adult males.

Table 20. Summary statistics for annual modified minimum home ranges by sexes for the Rocky Mountain Front, 1977-87.

Sex	N	Average AHR (Mod.Min.)(km.)	Range	S.D.
Male	13	313.0	76 - 633	190.2
Female	38	161.4	11 - 446	94.3

A one way AOV indicated no difference existed between modified minimum home ranges from females of different age and reproductive status. The comparison of females with cubs and without cubs was again confounded by the females without cubs from the Badger-Two Medicine area.

Table 21. Comparison of annual modified minimum home range by sex, age, and reproductive status for the Rocky Mountain Front, 1977-87.

Animal status	N	Average AHR (mod. min.)(km.)	Homogeneous groups
Adult female (no cubs)	9	124.2	*
Subadult female	10	151.1	*
Adult female (w/cubs)	8	161.8	**
Adult female (w/yrlgs)	11	200.8	**
Adult males	6	273.4	**
Subadult males	7	346.9	*

Composite home ranges were mapped for adult females, subadult females, subadult males and adult males with at least two years data (Figures 27, 28, and 29). No significant difference was found between the size of subadult and adult female home ranges (P<0.05) so the data from females were pooled (Table 22). As with AHR, the composite ranges of subadult males were the largest while the pooled females were the smallest. Composite modified minimum home ranges were not calculated for subadult males because they dispersed so widely between years that these ranges could not be considered a valid measure of home range. The mean composite

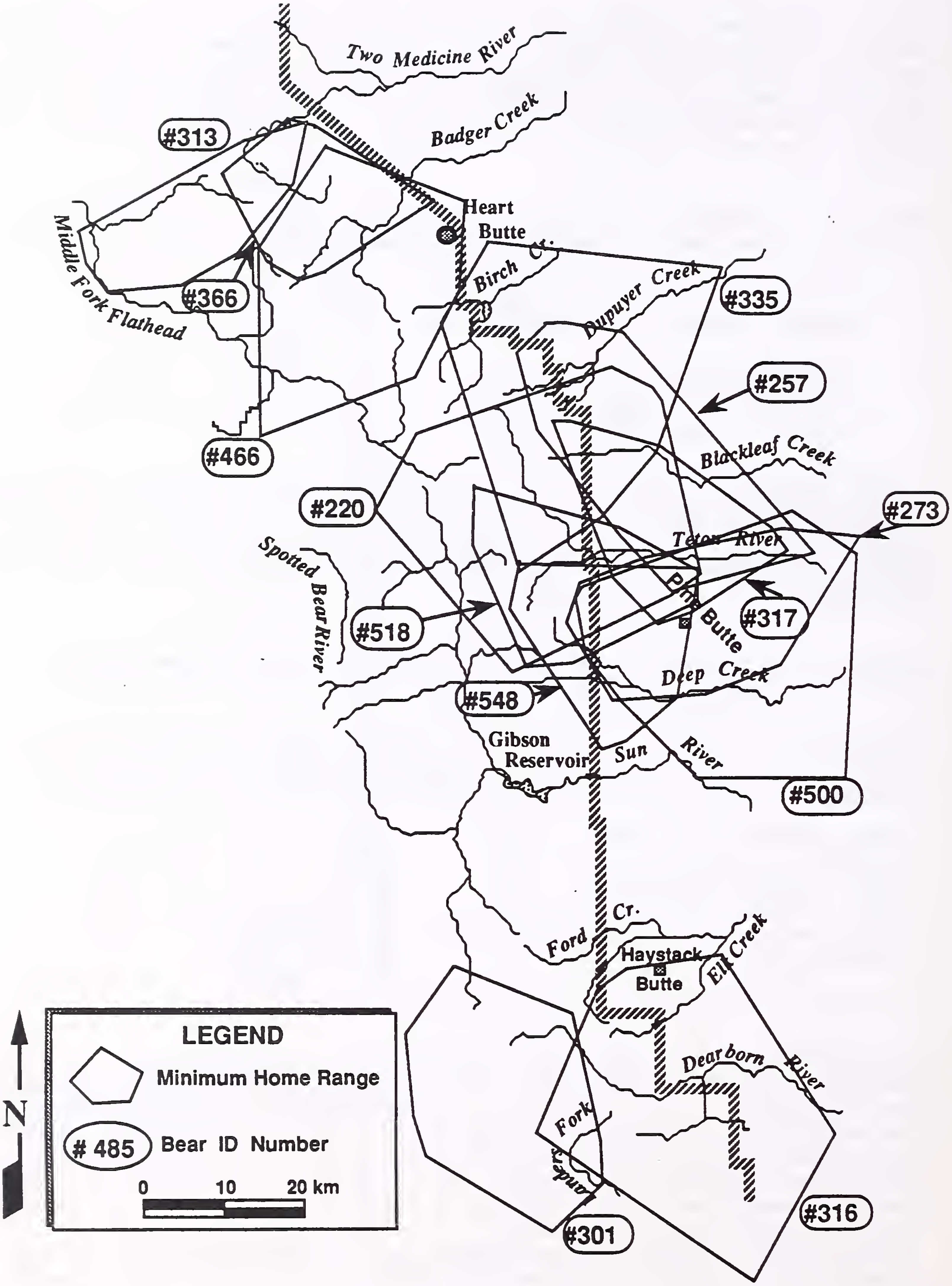


Figure 27. Composite home ranges of adult and subadult female grizzly bears, 1977-87.

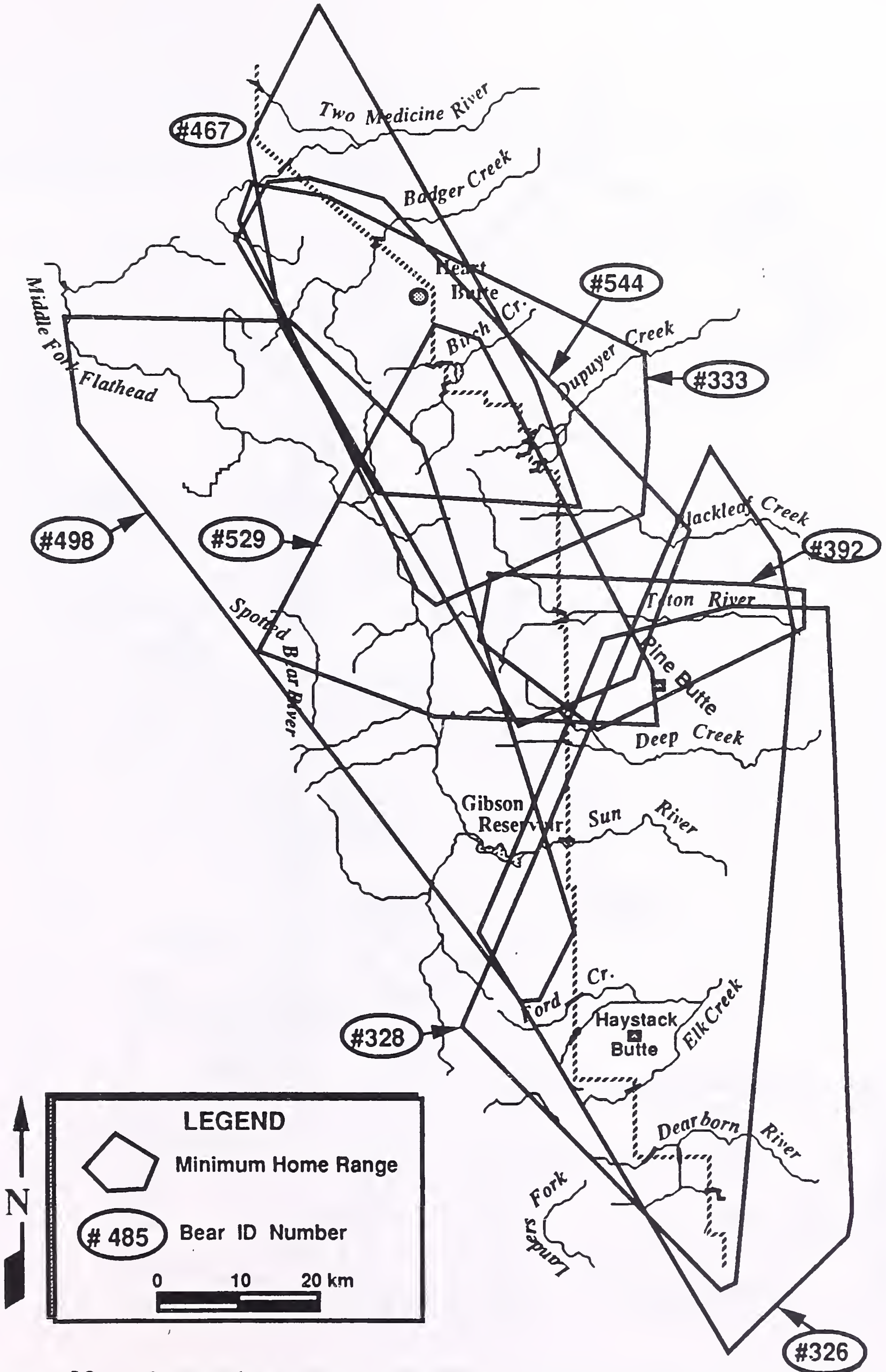


Figure 28. Composite home ranges of subadult male grizzly bear, 1980-87.

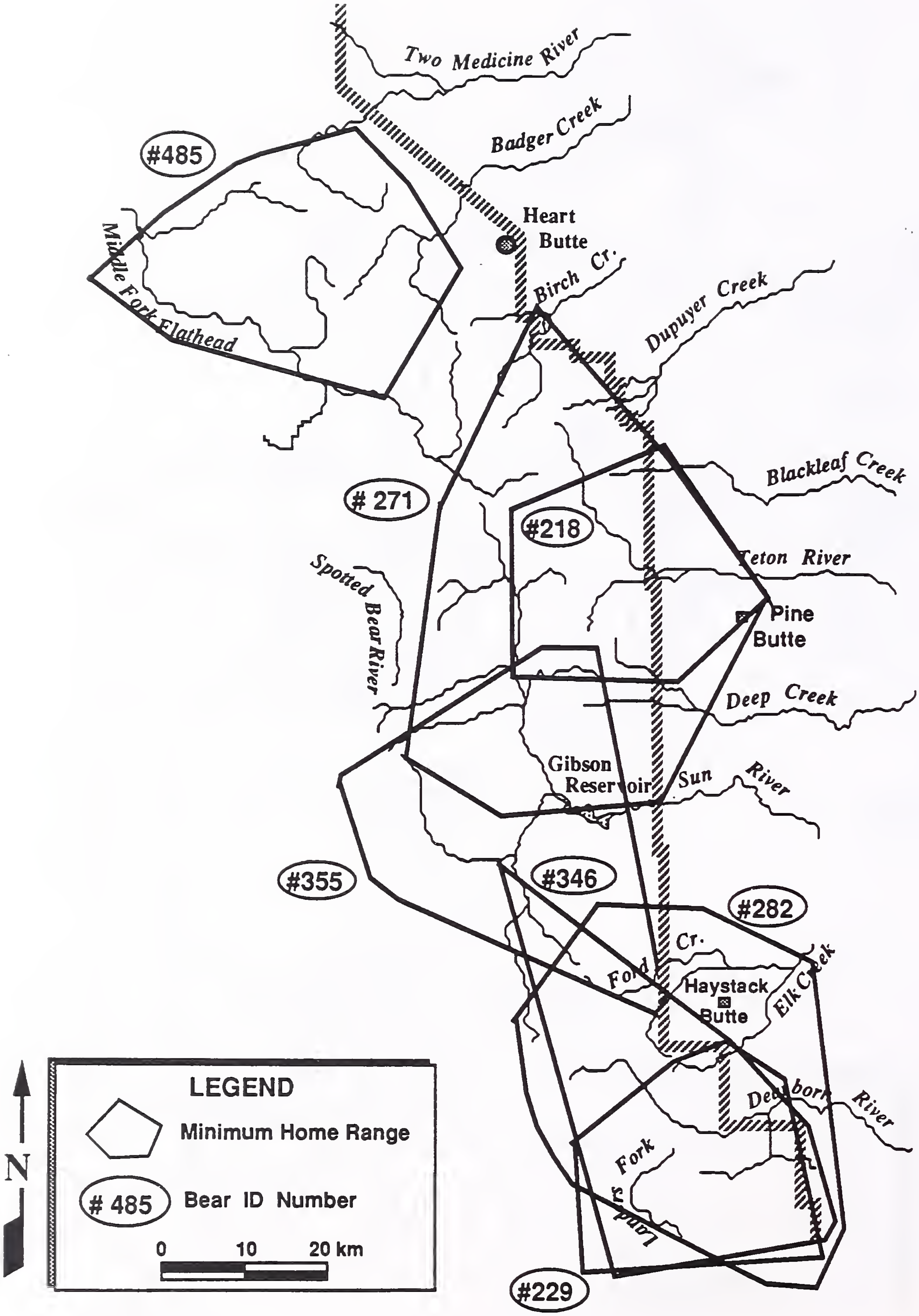


Figure 29. Composite home ranges of adult male grizzly bears, 1977-87.

modified minimum range of adult males was significantly larger than for females pooled.

Table 22. Composite home ranges of grizzly bears on the Rocky Mountain Front, 1977-87.

Bear no.	Minimum (km^2)	Modified minimum (km^2)	No fixes
Adult males			
485	873.3	502.99	78
218	661.99	--	39
271	1709.13	1374.70	84
355	1084.45	872.75	94
282	1389.22	1097.73	75
346	1000.04	--	30
229	649.81	--	19
Mean	1052.57	962.04	
S.D.	386.24	368.51	
Subadult Males			
467	1300.00	--	27
333	1484.75	--	94
544	1747.63	--	72
498	2333.93	--	53
328	2300.07	--	41
392	453.81	--	45
529	1366.39	--	35
326	2909.81	--	32
Mean	1724.56		
S.D.	753.74		
Females			
313	302.13	238.37	104
366	298.79	223.59	130
466	554.34	207.90	56
257	619.97	441.90	268
335	919.50	635.18	144
220	1022.99	713.17	258
548	385.50	257.00	48
273	528.30	342.19	249
301	569.71	326.80	83
500	890.68	496.73	154
317	391.66	195.83	52
518	379.56	257.12	53
316	928.10	412.20	90
Mean	599.33	365.23	
S.D.	258.06	166.91	

An adult bear's home range size is probably most influenced by habitat, sex, age, and to a lesser extent reproductive status. Adult females appeared to establish ranges of a size more directly correlated with habitat conditions. Smaller home range size of females in the Badger-Two Medicine area, where habitat is richer and provides abundant and well distributed vegetative food resources support this hypothesis.

It is hypothesized that the adult female bear maximizes the conversion of energy into progeny. She becomes more intimately familiar with a smaller portion of habitat, exploiting it more efficiently. This intimate knowledge begins accumulating as a subadult. Smaller ranges probably lead to better cub survival as well as maximizing the females contribution to the population gene pool.

In contrast to females it is hypothesized that the males extract energy from a much larger area, navigating over such an expanse that an intimate knowledge of the home range is unlikely. The male strategy for maximizing reproductive output is to include the most females within his home range. In addition, perhaps social dominance and increased mobility of male bears allows them to select the best patches of habitat over this larger range.

Given these assumptions are correct, comparisons of female home range size from different regions may be the best relative measure of habitat quality that can be attained without exhaustive habitat evaluation and mapping (Table 23). Comparisons of data from the North Fork Flathead, South Fork Flathead, Mission Mtns. and the east front indicate that there do exist considerable differences in female home range size in the North American Continent which can be best explained by differences in habitat conditions (principally climate and elevation).

Rocky Mountain East Front bears in the southern BMU's have home ranges more similar in size to the Yellowstone Ecosystem than to adjacent areas of western Montana. The Badger-Two Medicine bears on the east front had home ranges of similar size to bears from western Montana. Bears within the wetter, vegetatively richer environments appeared to range the least. Bears in drier environments with patches of high quality habitat ranged more. Our study area exists along a precipitation and habitat gradient from S.E. to the N.W. which demonstrates the relationship of habitat, climate, and home range size.

Activity Patterns of Grizzly Bears

Activity patterns measured on the Rocky Mountain Front were previously reported (Aune et al 1982, 1983, 1984, and 1986). Aune et al (1984) discuss the hypothesis that there may be differences in activity patterns between bears in remote areas and bears in areas with high levels of human intrusion. To test this hypothesis we examined east front bear data from 1979-86 (Table 24).

Table 23. Home ranges of grizzly bears from the Yellowstone, Northern Continental Divide, and Canada (information from the Grizzly Bear Compendium 1987).

Area	Home ranges (km^2.)					
	Adult males	(N)	Adult females	(N)	Subadult males	(N)
Yellowstone (Knight et al. 1984)	1970[1] 828[2]		874[1] 384[2]		- -	
Rocky Mountain East front[3] (this study)	1053[1] 912[2]	(6) (18)	599[1] 350[2]	(13) (43)	1725[1] 1095[2]	(8) (9)
Badger-Two Med. (this study)	510	(2)	185	(9)	-	
Mission Mtns. (Servheen and Lee 1979)	1398	(3)	133	(2)	-	
S.Fk. Flathead (Mace and Jonkel 1979, Mace and Jonkel 1980)	286	(5)	99	(2)	261	(4)
N. Fk. Flathead River, B.C. (McLellan 1981)	446	(5)	200	(5)	156	(4)
Interior B.C. Revelstoke Area (Simpson et al. in Prep)	297	(7)	79	(3)	125	(1)

[1] Composite life ranges

[2] Annual home ranges

[3] Adult and subadult females were pooled for the east front data.

Activity data were insufficient to test an individual bear within two different settings or during the spring period. However data were sufficient to compare groups of bears during the summer/fall period.

Data from 17 monitoring sessions were valid to test this hypothesis. We excluded sessions involving impact monitoring because the influence of disturbances would bias this sample.

Sessions were also selected according to the ability to format data according to Garshelis and Pelton (1980) and to include as many different bears as possible.

Table 24. Data from activity monitoring sessions 1979-86.

	Number of bears	Number of sessions	Hours	Average hr/session
1979	2	2	36.0	18.0
1981	4	15	204.9	13.6
1982	5	11	105.7	9.6
1983	4	11	102.0	9.3
1985	1	2	56.0	28.0
1986	3	5	107.0	21.4
	9	46	611.6	13.3

Ten sessions, involving 152 hours of monitoring on five grizzlies, were combined to represent the average activity patterns of lowland bears. Three sessions were included which did not involve monitoring of motion sensitive collars, however, these sessions were necessary to provide a stronger representation from the daytime period. The data used was biased toward sampling of the dusk to dawn period since monitoring in 1979-83 was primarily directed during the time when bears were active and moving. We do not feel that this bias caused a serious problem in this analysis. Most likely daytime activity may be underestimated but the pattern observed was real and matched those observed in monitoring sessions of individuals in the group not included in our analysis.

Seven sessions, involving 163 hours of monitoring on three different grizzlies, were used to represent the activity pattern of backcountry bears. All sessions included bears fitted with motion sensitive collars. Sampling was uniform throughout a 24 hour period within this group.

Aune and Stivers (1985) discussed the nocturnal habits of grizzly bears along the Rocky Mountain Front lowlands. In the sample of lowland bears a nocturnal activity pattern confirms previous observations (Figure 30). In general nocturnal patterns have been noted in all bears when utilizing low elevations habitats along the front (Aune et al 1982, 1983, and 1984). These patterns usually vary in length according to the length of day and temperatures. Activity during the daylight hours in these environments is generally confined to the dusk or dawn hours. Occasional midday feeding bouts in dense secure cover while berries are ripe have been recorded for lowland bears.

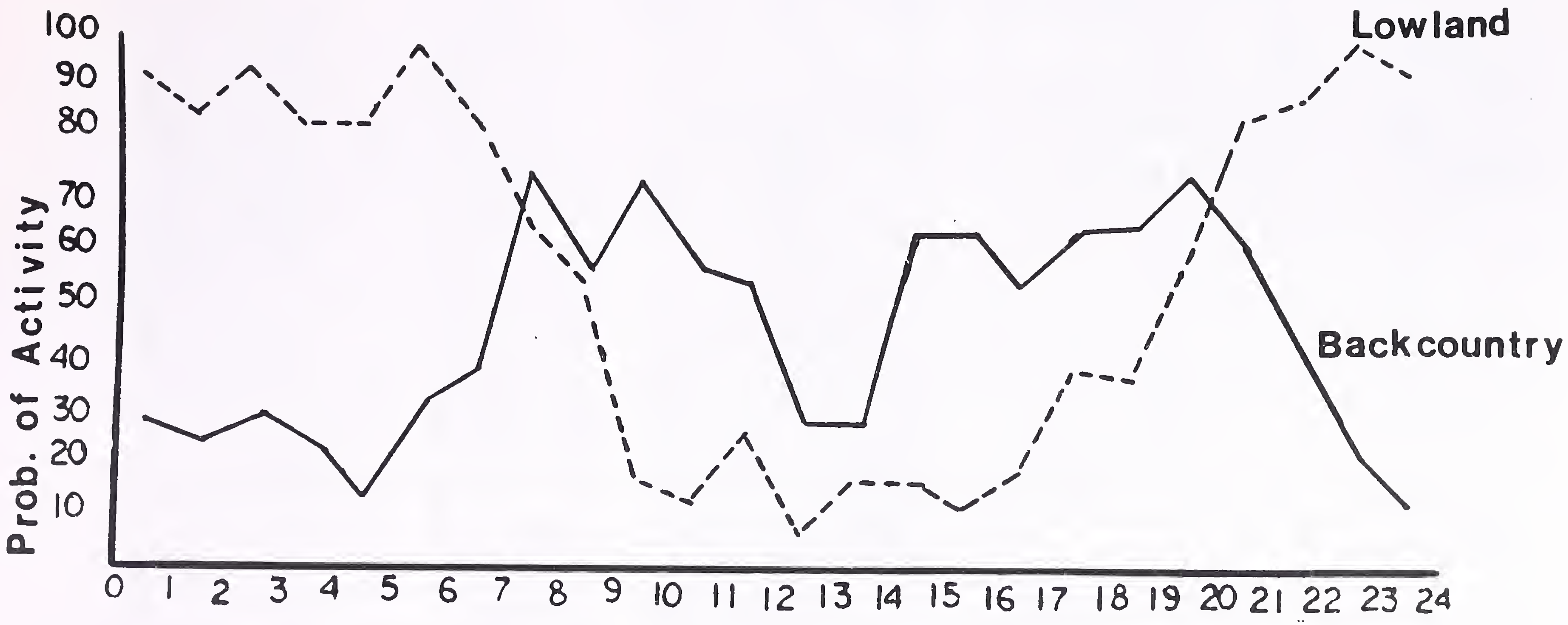


Figure 30. Average activity patterns of lowland and backcountry grizzly bears, 1979-86.

In contrast to the lowland bears the average activity pattern of backcountry bears is crepuscular with peaks of activity near 0700 and 1900 hours (Figure 30). The actual activity patterns of individuals was variable. Diurnal, crepuscular and complex patterns of interspersed periods of activity were recorded. In some cases as many as five distinct activity peaks occurred during one 24 hour monitoring period.

There was no significant difference (P=0.90) in the average hours of vigorous activity between lowland and backcountry bears (Table 25). There was no significant difference (P=0.25) difference in the average hours of moderate activity between lowland and backcountry bears. It appeared that both bear groups spent equal amounts of time engaged in vigorous activities within a 24 hour period, usually 10-15 hours. The average probability of activity of lowland bears was significantly higher (P=0.0001) than backcountry bears during vigorous activity. The average probability of activity was significantly lower (P=0.087) during moderate activity for lowland bears when compared to backcountry bears.

Table 25. Hours and the level of activity for two bear groups on the Rocky Mountain East Front, 1979-86.

	Hours		Prob. of activity		
Activity level	Mean	Sample	Mean	S.D.	N
Vigorous (Prob. > 50%)					
Lowland	13.5	85.5	82.4	13.3	14
Backcountry	12.0	81.5	62.5	6.7	12
	Chi. Sq. = .0015			F = 21.25	
Moderate (Prob. < 50%)					
Lowland	10.5	66.5	20.0	9.9	10
Backcountry	12.0	81.5	26.9	8.7	12

These differences could be a product of the level of human intrusion influencing bears, age and sex of the bear, or differences in habitat and food resources. Schleyer (1983) suggested that food, cover, and temperature have major influences on bear activity patterns. Lowland bears on the front were exposed to concentrated food and cover along cool riparian areas in higher temperature environments. They also exposed to high levels of human intrusion throughout the daylight period. It appeared that lowland bears have adopted an activity pattern to accommodate their environment and human competition.

Geist (1971) stated that, "mammals learn to minimize encounters with humans if harassed enough by reducing activity to areas, habitats and times of day where encounters with humans are minimal." Grizzly bears along the lowlands of the Rocky Mountain Front are exposed to many forms of harassment throughout the summer-fall period and are hunted during the fall. These pressures over time may have resulted in the evolution of activity patterns from crepuscular toward a nocturnal pattern.

Andrews (1979) indicated that shifts in "time territories" may be a mechanism for reducing stress in behavioral interactions. Interactions between bears and humans along the Rocky Mountain Front can be a matter of life and death for either party. The adjustment of "time territories" may be essential for the maintenance of grizzly populations across the front lowlands.

The behavioral plasticity of bears is clearly demonstrated by their ability to accommodate human activities throughout the North American Continent. The fact that bears can shift into time territories may impart a great survival advantage to the species, however, compressing the activities of grizzly bears into a narrow time territory could increase intraspecific competition and result in a loss in carrying capacity of habitat. Increased competition for food and space could result in lowered survival for socially subordinate animals. In backcountry settings along the front it was possible for a subordinate and dominant bear to access similar habitats by using them at different time periods. In the lowland areas of the front subordinate animals may be forced to be actively competing for similar habitat in the same time territory as more socially dominant bears or conduct their activities within the time territory of humans.

Further study is needed to determine if adjustments are made in activity patterns during movements to and from the lowlands and backcountry areas by an individual bear. Also further sampling is needed to reinforce data sets thus far analyzed. Information is also needed on the influence of these shifts in activity patterns on energetics of the bear and its ability to access environmental resources.

Food Habits

One thousand and ninety four grizzly bear scats were collected and analyzed for content from 1979-87. Sixty-one percent of the scats collected were from forty-two radio collared grizzly bears. Thirty nine percent of the scats were collected from grizzly bears which could be marked or unmarked. Thirty percent of the total scats collected were found at feed sites and 15% were collected at bed sites. The remainder were collected along trails, roads and other sites.

Grizzly bear scats contained food items from 11 major categories including; mammals, insects, birds, trees (pine nuts), sporophytes, forbs, roots and corms, graminoids, shrubs (fruit), garbage, and other (debris). Bear food categories were ranked according to importance value percent (Table 26). Graminoids, and insects were the two most commonly occurring bear foods along the east front and have high frequency values. In contrast seasonally important or less common foods such as fruit, mammals, sporophytes, roots and corms, and pine nuts had lower frequency values. Graminoids, roots and corms, and fruit had the highest percent volume and highest importance values of all bear food categories.

Table 26. Annual summary by major categories of grizzly bear foods as determined from scat content analysis (N=1094).

Taxonomic group	Frequency	Percent volume	Importance value	Importance value %
Graminoids	562	23.2	11.9	37.6
Shrubs	319	18.8	5.5	17.3
Roots/corms	311	15.5	4.4	13.9
Other (debris)	395	10.1	3.6	11.4
Mammals	272	8.8	2.2	6.9
Insects	349	6.1	1.9	6.1
Forbs	188	8.1	1.4	4.4
Trees (mast)	91	5.9	0.5	1.5
Sporophytes	100	3.5	0.3	1.0
Birds	9	0.03	0.0	0.0
Garbage	4	0.04	0.0	0.0

Grizzly bear food habits were analyzed monthly to determine seasonal trends (Figure 31). Major shifts in the importance value percent were noted for food categories such as trees, shrubs, graminoids, forbs, and roots and corms (Table 27). Fruits and masts produced provide over 60% of the volume in the fall scat sample. Graminoid, forbs, and roots and corms were prevalent in the scat sample during the spring and summer.

The most frequently identified food items included pine nuts, Prunus virginianus, Shepherdia canadensis, Equisetum spp., unidentified graminoids, Poa, unidentified grass/sedge, unidentified forb, Taraxacum spp., deer, domestic cattle and ants (Table 28). These items had percent volumes greater than 3% with the exception of deer. The top ranked items as determined from importance value percent were unidentified grass/sedge, domestic cattle, and ants.

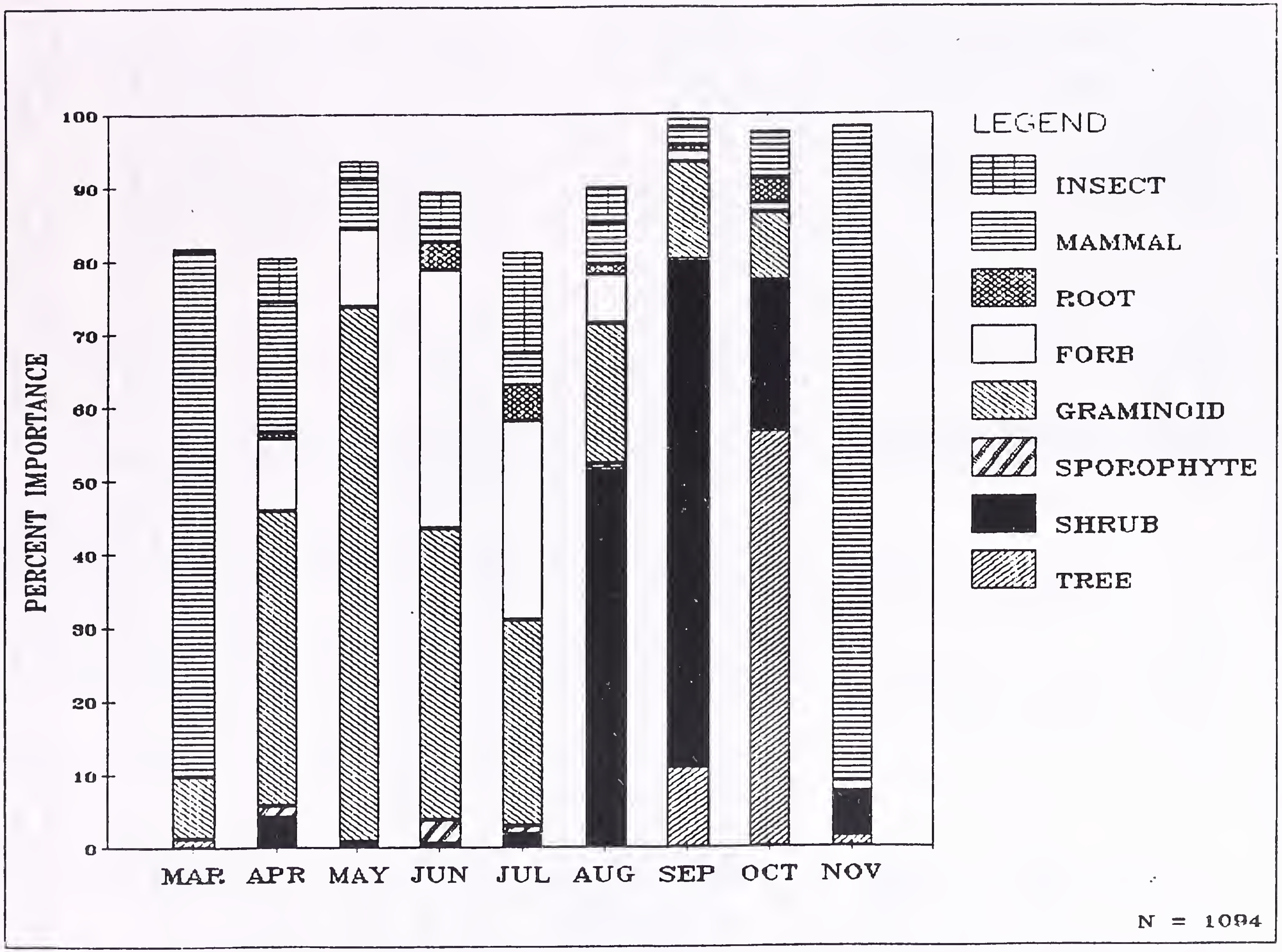


Figure 31. Grizzly bear food habits.

Table 27. Frequency and importance value percent of bear food categories by seasons.

Category	Spring freq.	Spring imp.%	Summer freq.	Summer imp.%	Fall freq.	Fall imp.%
	N=356		N=507		N=231	
Graminoids	252	56.7	233	26.5	77	12.0
Shrubs	37	0.8	167	21.5	115	53.4
Roots/corms	137	16.8	145	13.7	29	3.0
Other (debris)	154	10.1	211	15.9	30	1.4
Mammals	97	5.9	125	5.9	50	6.2
Insects	132	4.0	190	10.0	27	0.7
Forbs	76	4.1	92	5.6	20	0.7
Trees (mast)	6	0.0	12	0.1	73	22.6
Sporophytes	47	1.6	49	1.0	4	0.0
Birds	4	0.0	1	0.0	4	0.0
Garbage	1	0.0	1	0.0	2	0.0

Domestic cattle and deer were the most common mammals eaten both in frequency and volume. Other large herbivores in the diets were domestic sheep, elk, bison, moose, and black bears. The percent frequency and percent volume for domestic cattle were 10.88 and 3.94 representing 44.2% and 45.0% of the total frequency and volume of all mammals in the scats analyzed. Most of the domestic cattle are available from livestock boneyards along the east front.

A large amount of debris was found in scats. Ingestion of debris appeared to be related to mammal feeding, root digging, pine nut digging, and insect feeding. During these activities bears ingest large amounts of dirt, litter, and wood chips. A small amount of garbage was found in the scat contents. Many boneyards of the front include garbage and open pit garbage dumps were also available.

Evidence of bears feeding on birds was noted in the sample of scats analyzed. The activity detected was concentrated in the May-September period. We hypothesize that some feeding may be related to the nesting season of many birds and the possibility of opportunistic predation on ground nesting bird species. Undetermined grouse species was the only bird identified in the sample. Grouse common to the area included ruffed grouse, spruce grouse, blue grouse, and sharp-tailed grouse.

Plant parts selected by grizzlies varied with species. Berries and leaf parts were common items from shrub species. Graminoids were primarily composed of stem or leaf parts. The parts of forbs varied considerably by species. Upper plant parts such as leaves, stems, fruit or seed, and flowers were commonly eaten for species such as Heracleum lanatum, Angelica spp., Equisetum spp., Taraxacum

Table 28. Food habits of grizzly bears along the east front, 1978-1987.

Item	Freq.	%Freq.	Vol.	%Vol.	%Comp.	Impt	%Impt
** Tree							
Pinus albicaulis	56	5.12	4882	4.46	87.18	0.228	2.01
Pinus contorta	7	0.64	122	0.11	17.43	0.001	0.01
Pinus flexilis	1	0.09	1	0.00	1.00	0.000	0.00
Populus tremuloides	4	0.37	5	0.00	1.25	0.000	0.00
Populus trichocarpa	2	0.18	9	0.01	4.50	0.000	0.00
Juniperus horizontalis	2	0.18	60	0.05	30.00	0.000	0.00
Fraxinus	1	0.09	25	0.02	25.00	0.000	0.00
Juniperus	1	0.09	5	0.00	5.00	0.000	0.00
Picea	1	0.09	2	0.00	2.00	0.000	0.00
Pinus	14	1.28	1253	1.15	89.50	0.015	0.13
Populus	1	0.09	2	0.00	2.00	0.000	0.00
Pyrus	2	0.18	80	0.07	40.00	0.000	0.00
Tree-unident	2	0.18	3	0.00	1.50	0.000	0.00
Total tree	91	8.32	6449	5.89	70.87	0.490	1.56
** Shrub							
Shrub-unident	1	0.09	1	0.00	1.00	0.000	0.00
Arctostaphylos	29	2.65	924	0.84	31.86	0.022	0.19
Berberis	4	0.37	125	0.11	31.25	0.000	0.00
Prunus	16	1.46	1078	0.99	67.38	0.014	0.12
Rhamnus	1	0.09	33	0.03	33.00	0.000	0.00
Ribes	4	0.37	125	0.11	31.25	0.000	0.00
Rosa	27	2.47	1277	1.17	47.30	0.029	0.26
Shepherdia	2	0.18	55	0.05	27.50	0.000	0.00
Sorbus	1	0.09	84	0.08	84.00	0.000	0.00
Vaccinium	2	0.18	115	0.11	57.50	0.000	0.00
Linnaea	1	0.09	1	0.00	1.00	0.000	0.00
Acer glabrum	1	0.09	100	0.09	100.00	0.000	0.00
Amelanchier alnifolia	37	3.38	2675	2.45	72.30	0.083	0.73
Cornus stolonifera	20	1.83	874	0.80	43.70	0.015	0.13
Crataegus douglasii	1	0.09	100	0.09	100.00	0.000	0.00
Prunus virginiana	83	7.59	5299	4.84	63.84	0.367	3.24
Rhamnus alniforia	1	0.09	27	0.02	27.00	0.000	0.00
Sambucus racemosa	1	0.09	100	0.09	100.00	0.000	0.00
Shepherdia canadensis	73	6.67	4235	3.87	58.01	0.258	2.28
Vaccinium globulare	14	1.28	1220	1.12	87.14	0.014	0.12
Vaccinium scoparium	9	0.82	364	0.33	40.44	0.003	0.03
Ribes montigenum	1	0.09	97	0.09	97.00	0.000	0.00
Vaccinium membranaceum	1	0.09	100	0.09	100.00	0.000	0.00
Shepherdia argentia	6	0.55	355	0.32	59.17	0.002	0.02
Eleagnus angustifolia	1	0.09	5	0.00	5.00	0.000	0.00
Arctostaphylos uva-ursi	37	3.38	1163	1.06	31.43	0.036	0.32
Berberis repens	2	0.18	35	0.03	17.50	0.000	0.00
Total shrub	315	28.79	20535	18.77	65.19	5.405	17.17
** Sporophyte							
Equisetum	87	7.95	3588	3.28	41.24	0.261	2.30

Table 28. Food habits of grizzly bears along the east front, 1978-1987

Item	Freq.	%Freq.	Vol.	%Vol.	%Comp.	Impt	%Impt
Lycopodium	4	0.37	9	0.01	2.25	0.000	0.00
Puffballs	1	0.09	10	0.01	10.00	0.000	0.00
Mushroom	1	0.09	4	0.00	4.00	0.000	0.00
Lichen	1	0.09	17	0.02	17.00	0.000	0.00
Equisetum arvense	9	0.82	359	0.33	39.89	0.003	0.03
Total sporophyte	100	9.14	3802	3.48	38.02	0.318	1.01
** Graminoid							
Graminoid-unident	94	8.59	4480	4.10	47.66	0.352	3.11
Agropyron	3	0.27	45	0.04	15.00	0.000	0.00
Agrostis	1	0.09	35	0.03	35.00	0.000	0.00
Bromus	10	0.91	180	0.16	18.00	0.001	0.01
Calamagrostis	2	0.18	75	0.07	37.50	0.000	0.00
Carex	34	3.11	1195	1.09	35.15	0.034	0.30
Festuca	6	0.55	220	0.20	36.67	0.001	0.01
Glyceria	1	0.09	20	0.02	20.00	0.000	0.00
Juncus	1	0.09	50	0.05	50.00	0.000	0.00
Melica	2	0.18	10	0.01	5.00	0.000	0.00
Poa	81	7.40	2354	2.15	29.06	0.159	1.40
Scirpus	5	0.46	170	0.16	34.00	0.001	0.01
Triticum	4	0.37	135	0.12	33.75	0.000	0.00
Grass	5	0.46	310	0.28	62.00	0.001	0.01
Grass/sedge	360	32.91	16300	14.90	45.28	4.904	43.27
Bromus anomalus	1	0.09	60	0.05	60.00	0.000	0.00
Carex scopulorum	1	0.09	40	0.04	40.00	0.000	0.00
Phleum alpinum	2	0.18	39	0.04	19.50	0.000	0.00
Phleum pratense	3	0.27	130	0.12	43.33	0.000	0.00
Avena sativa	24	2.19	1534	1.40	63.92	0.031	0.27
Total graminoid	557	50.91	25414	23.23	45.63	11.830	37.57
** Forb							
Forb-unident	50	4.57	1049	0.96	20.98	0.044	0.39
Angelica	7	0.64	215	0.20	30.71	0.001	0.01
Cardamine	2	0.18	120	0.11	60.00	0.000	0.00
Cirsium	14	1.28	465	0.43	33.21	0.006	0.05
Claytonia	1	0.09	35	0.03	35.00	0.000	0.00
Comandra	1	0.09	10	0.01	10.00	0.000	0.00
Cornus	1	0.09	45	0.04	45.00	0.000	0.00
Erigeron	1	0.09	2	0.00	2.00	0.000	0.00
Eriogonum	1	0.09	2	0.00	2.00	0.000	0.00
Hedysarum	19	1.74	1669	1.53	87.84	0.027	0.24
Heracleum	13	1.19	635	0.58	48.85	0.007	0.06
Lathyrus	35	3.20	893	0.82	25.51	0.026	0.23
Ligusticum	1	0.09	20	0.02	20.00	0.000	0.00
Lithophragma	1	0.09	70	0.06	70.00	0.000	0.00
Lomatium	16	1.46	882	0.81	55.13	0.012	0.11
Melilotus	1	0.09	20	0.02	20.00	0.000	0.00
Mitella	1	0.09	2	0.00	2.00	0.000	0.00

Table 28. Food habits of grizzly bears along the east front, 1978-1987

Item	Freq.	%Freq.	Vol.	%Vol.	%Comp.	Impt	%Impt
Osmorhiza	26	2.38	1774	1.62	68.23	0.039	0.34
Polygonum	3	0.27	36	0.03	12.00	0.000	0.00
Ranunculus	1	0.09	5	0.00	5.00	0.000	0.00
Taraxacum	128	11.70	6274	5.73	49.02	0.670	5.91
Tragopogon	4	0.37	309	0.28	77.25	0.001	0.01
Trifolium	30	2.74	534	0.49	17.80	0.013	0.11
Valeriana	1	0.09	20	0.02	20.00	0.000	0.00
Vicia	1	0.09	10	0.01	10.00	0.000	0.00
Centaurea	3	0.27	25	0.02	8.33	0.000	0.00
Cerastium	2	0.18	12	0.01	6.00	0.000	0.00
Viburnum	1	0.09	30	0.03	30.00	0.000	0.00
Compositae-asteraceae	1	0.09	80	0.07	80.00	0.000	0.00
Leguminosae-fabaceae	1	0.09	80	0.07	80.00	0.000	0.00
Umbelliferae-apiaceae	33	3.02	1345	1.23	40.76	0.037	0.33
Liliaceae	3	0.27	6	0.01	2.00	0.000	0.00
Angelica arguta	1	0.09	80	0.07	80.00	0.000	0.00
Claytonia lanceolata	1	0.09	10	0.01	10.00	0.000	0.00
Erigeron divergens	1	0.09	60	0.05	60.00	0.000	0.00
Heracleum lanatum	44	4.02	3050	2.79	69.32	0.112	0.99
Heuchera cylindrica	3	0.27	55	0.05	18.33	0.000	0.00
Ligusticum canbyi	1	0.09	100	0.09	100.00	0.000	0.00
Listera borealis	1	0.09	20	0.02	20.00	0.000	0.00
Osmorhiza chilensis	5	0.46	305	0.28	61.00	0.001	0.01
Vicia americana	1	0.09	15	0.01	15.00	0.000	0.00
Cirsium scariosum	7	0.64	280	0.26	40.00	0.002	0.02
Lomatium cous	12	1.10	766	0.70	63.83	0.008	0.07
Clatonia megarhiza	20	1.83	1145	1.05	57.25	0.019	0.17
Taraxacum officinale	22	2.01	1049	0.96	47.68	0.019	0.17
Veronica biloba	1	0.09	20	0.02	20.00	0.000	0.00
Total root	119	10.88	7934	7.25	66.67	0.789	2.51
Total forb	341	31.17	17880	16.34	52.43	5.090	16.17
** Mammal							
Meat-unident	12	1.10	219	0.20	18.25	0.002	0.02
Large mammal-unident	45	4.11	1094	1.00	24.31	0.041	0.36
Elk	12	1.10	635	0.58	52.92	0.006	0.05
Bison	1	0.09	90	0.08	90.00	0.000	0.00
Domestic sheep	8	0.73	465	0.43	58.13	0.003	0.03
Rodent	2	0.18	13	0.01	6.50	0.000	0.00
Pocket gopher	1	0.09	25	0.02	25.00	0.000	0.00
Microtus	3	0.27	35	0.03	11.67	0.000	0.00
Deer	49	4.48	1858	1.70	37.92	0.076	0.67
Marmot	3	0.27	74	0.07	24.67	0.000	0.00
Moose	1	0.09	50	0.05	50.00	0.000	0.00
Domestic cattle	119	10.88	4312	3.94	36.24	0.429	3.79
Grizzly	7	0.64	249	0.23	35.57	0.001	0.01
Black bear	1	0.09	90	0.08	90.00	0.000	0.00
Horse	1	0.09	70	0.06	70.00	0.000	0.00

Table 28. Food habits of grizzly bears along the east front, 1978-1987

Item	Freq.	%Freq.	Vol.	%Vol.	%Comp.	Impt	%Impt
Lagomorph	3	0.27	95	0.09	31.67	0.000	0.00
Small mammal-unident	7	0.64	71	0.06	10.14	0.000	0.00
Spermophilus-citellus	8	0.73	88	0.08	11.00	0.001	0.01
Microtinae	5	0.46	47	0.04	9.40	0.000	0.00
Total mammal	269	24.59	9580	8.76	35.61	2.153	6.84
** Insect							
Insect-unident	3	0.27	48	0.04	16.00	0.000	0.00
Ant	317	28.98	5281	4.83	16.66	1.400	12.35
Larva	2	0.18	35	0.03	17.50	0.000	0.00
Bee	6	0.55	64	0.06	10.67	0.000	0.00
Grasshopper	1	0.09	1	0.00	1.00	0.000	0.00
Vespidae wasp	4	0.37	54	0.05	13.50	0.000	0.00
Moths	17	1.55	1130	1.03	66.47	0.016	0.14
Coleoptera	9	0.82	25	0.02	2.78	0.000	0.00
Total insect	340	31.08	6638	6.07	19.52	1.886	5.99
** Bird							
Bird-unident	8	0.73	30	0.03	3.75	0.000	0.00
Grouse	1	0.09	2	0.00	2.00	0.000	0.00
Total bird	9	0.82	32	0.03	3.56	0.000	0.00
** Garbage							
Plastic	1	0.09	3	0.00	3.00	0.000	0.00
Paper	1	0.09	37	0.03	37.00	0.000	0.00
Tin foil	1	0.09	1	0.00	1.00	0.000	0.00
Eggs	1	0.09	5	0.00	5.00	0.000	0.00
Total garbage	4	0.37	46	0.03	11.50	0.000	0.00
** Other							
Debris	178	16.27	4516	4.13	25.37	0.672	5.93
Wood	64	5.85	1014	0.93	15.84	0.054	0.48
Trap bait	6	0.55	205	0.19	34.17	0.001	0.01
Dirt	207	18.92	3616	3.31	17.47	0.626	5.52
Rocks	105	9.60	1382	1.26	13.16	0.121	1.07
Needles	25	2.29	270	0.25	10.80	0.006	0.05
Cones	1	0.09	2	0.00	2.00	0.000	0.00
Total other	383	35.01	11005	10.06	28.73	3.522	11.19

spp., and Lathyrus spp. Roots, tubers and corms were parts selected for species such as Hedysarum spp., Lomatium spp., and Claytonia megarhiza.

A wide variety of berry producing species were identified as important in the diet of grizzlies along the front (Table 29).

The top four species constituted 77% of the total volume of berries in all scats. Vaccinium globulare is a species which was highly preferred by grizzly bears where it occurred along the front, however, it is infrequently encountered in most areas. Bears in the Badger-Two Medicine area concentrated frequently on Vaccinium globulare as well as Shepherdia spp. Vaccinium scoparium was very common at higher elevations along the front but produced infrequent crops of berries. Heavier use of the fruits of Arctostaphylos spp., Rosa spp., Ribes spp. and Cornus spp. were noted during years when the key berries were not producing.

Table 29. Berry producing species ranked according to importance percent for the Rocky Mountain Front, 1979-87.

Species	Rank
Prunus	1
Shepherdia	2
Amelanchier	3
Arctostaphylos	4
Rosa	5
Vaccinium	6
Cornus	7

The production of berries varied with species between years. It was noted that in several years the key mountain berry, Shepherdia, failed to produce while the lowland Chokecherry and Serviceberry managed fair crops. During these situations bears distributed themselves into regions accordingly. In most years the lowland berry species produced crops which were moderate to good but upland berry producing species like Shepherdia spp. and Vaccinium spp. were occasionally deficient.

Pine nuts were fed upon to some degree in all seasons, however, most of the use of pine nuts was during the fall (Figure 32). No measure of pine nut production was made during the study but observations suggested considerable variations in the nut crops. We found all of the pine nut feeding to occur south of Birch Creek and 93% of the records were at sites above 1890 m. (6200 ft.). The distribution of whitebark pine was concentrated in this region and in this elevational range. Very few cases of bears feeding upon limber pine nuts were recorded.

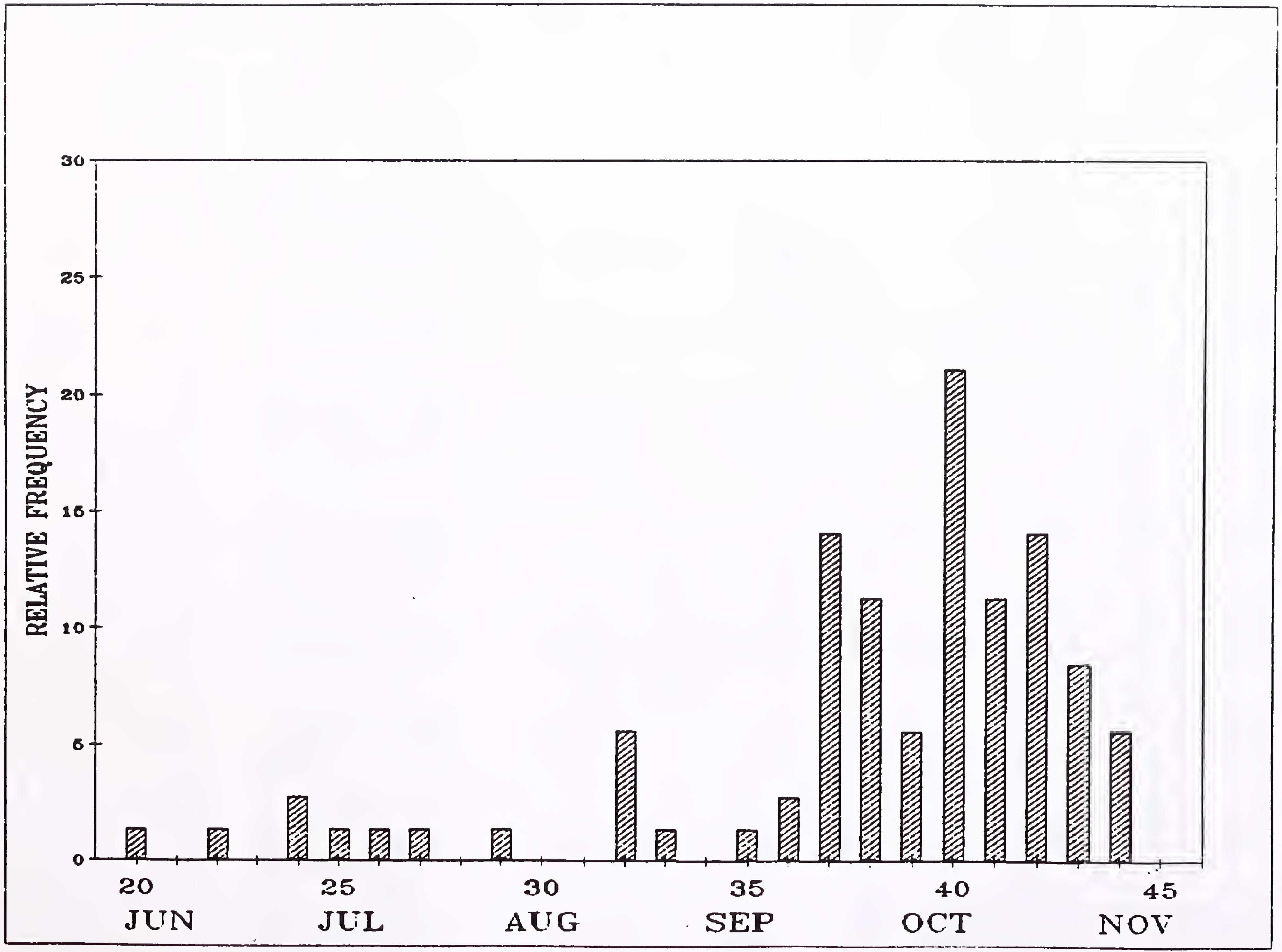


Figure 32. Grizzly bear feeding activity on whitebark pine nuts by week.

Dens and Denning

Seventy grizzly bear dens have been located since 1977 in or adjacent to the study area. Fifty-eight of these dens were located north of the Sun River and thirteen were south of the Sun River (Figures 33 and 34). Fifty-six of these dens were east of the Continental Divide and fifteen were located west of the Continental Divide.

Dens were present in eleven different land types and nine different habitat types. Grizzly bears denned in open nonforested slopes or forested slopes and seemed to select den sites based on physical characteristics such as slope, aspect, elevation, and soil type rather than vegetative cover.

Den data were stratified into two groups to test for differences between front slope dens and Continental Divide dens. A two sample t-test revealed no difference between data sets for slope (P=0.47), aspect (P=0.66), and elevation (P=0.33). A comparison of frequency histograms of aspect show no difference in aspect selection. Den data from the front region and Continental Divide region were then pooled for analysis.

Seventy-seven percent of the pooled sample of dens from the study were located on northerly aspects (Figure 35). However, each aspect category in the frequency histogram received some use for denning by grizzly bears. The aspects used probably reflect the availability of aspect in our study area and the selection of aspects which receive the greatest deposits of snow.

Dens ranged in elevation from 1555 m. (5100 ft.) to 2490 m. (8167 ft.) with a mean of 2151 m. (7055 ft.). Ninety-five percent of the dens were above 1900 m. (6232 ft.) (Figure 36). The few dens below this elevation were from locations west of the Continental Divide or in the Badger-Two Medicine area.

Grizzly bears denned on slopes ranging from 15-80% and averaged 57%. Ninety four percent were on slopes greater than 30% (Figure 37).

Dens from this study were compared to data from the South Fork of the Flathead region in Western Montana. Data from 22 dens were gathered from Gillespie and Jonkel (1980) and from Aune and Mace (Unpublished data) for the South Fork of the Flathead area. Dens in the South Fork were located at significantly lower elevations and steeper slopes. Dens on the South Fork Flathead were primarily on south and southwest aspects while dens from this study were primarily on north and northeast aspects (Figure 38).

All but four of the dens in this study were dug. In one area a large cave den was used by a female and her three yearlings. Three dens in the sample were used more than one year by the same grizzly

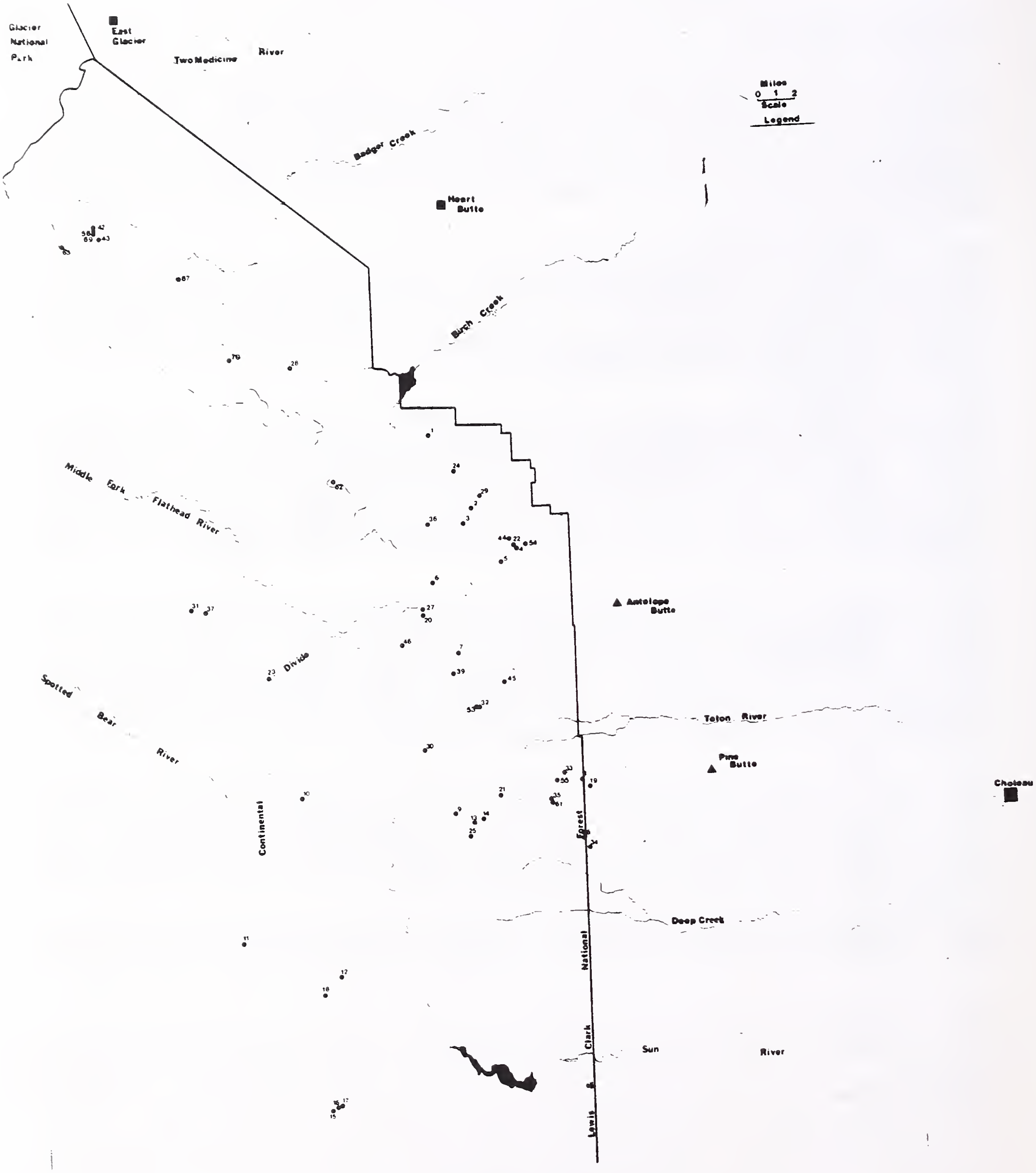


Figure 33. Den sites north of the Sun River, 1977-1988.

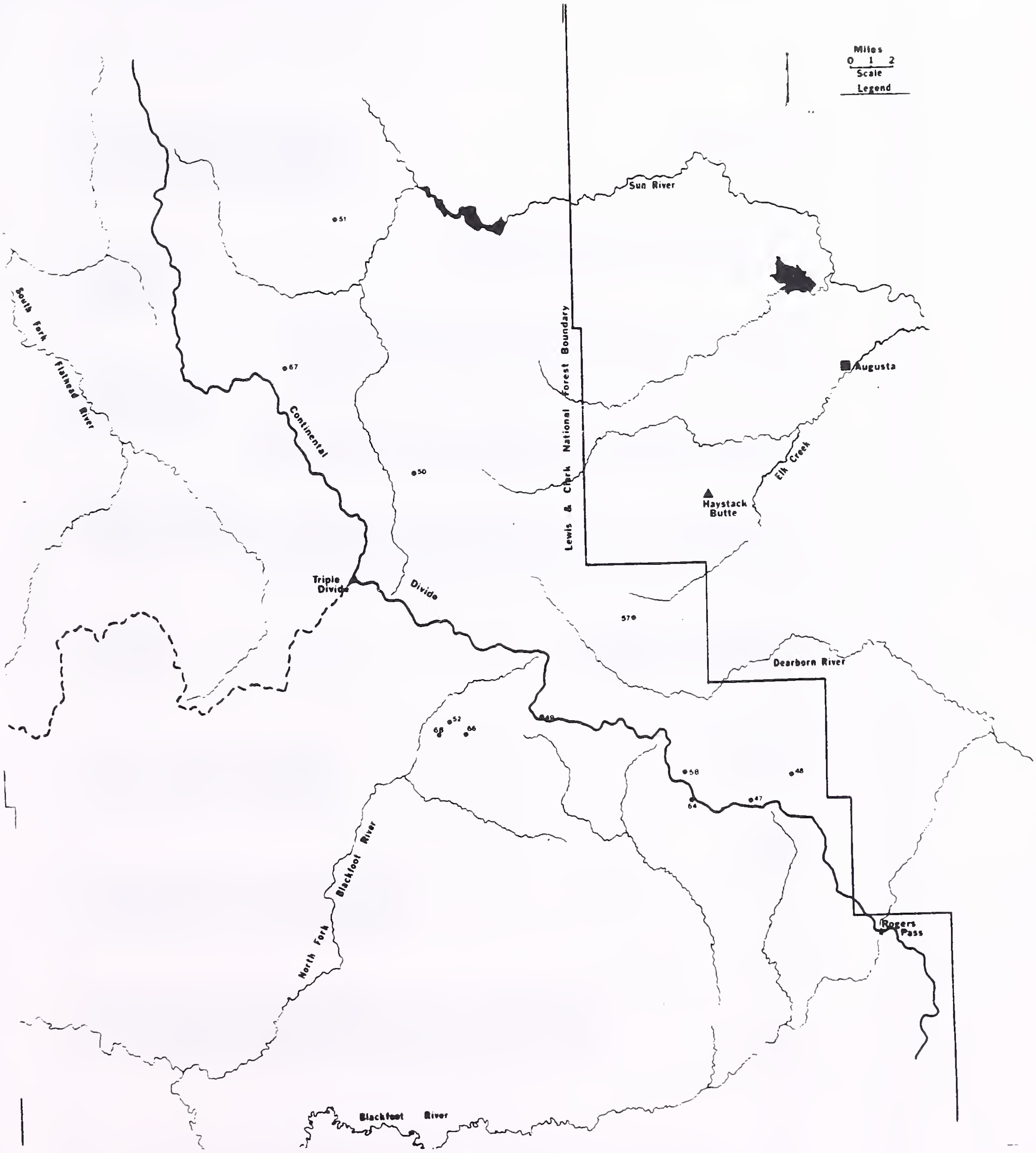


Figure 34. Den sites south of the Sun River, 1977-88.

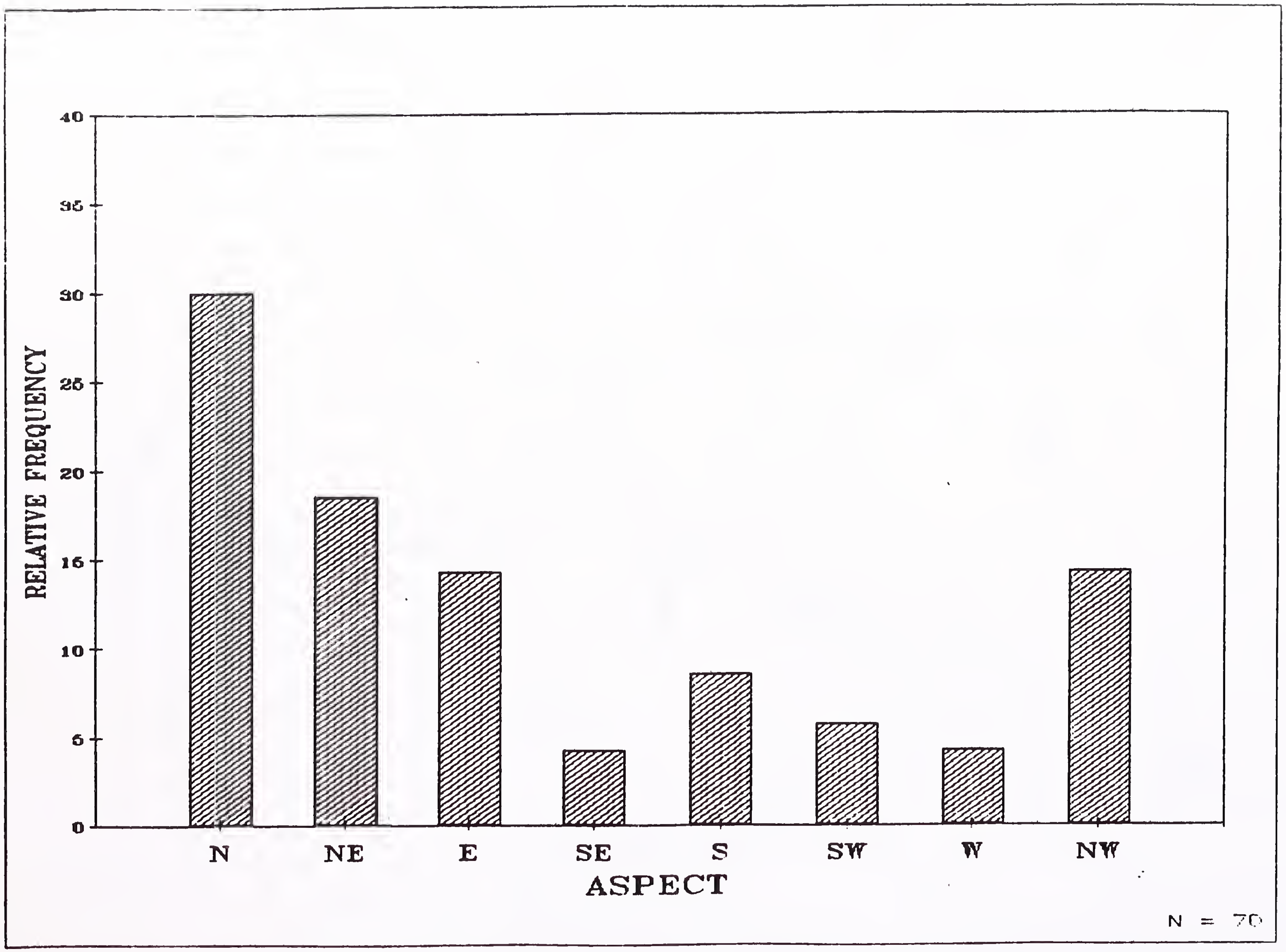


Figure 35. Aspect of grizzly bear dens.

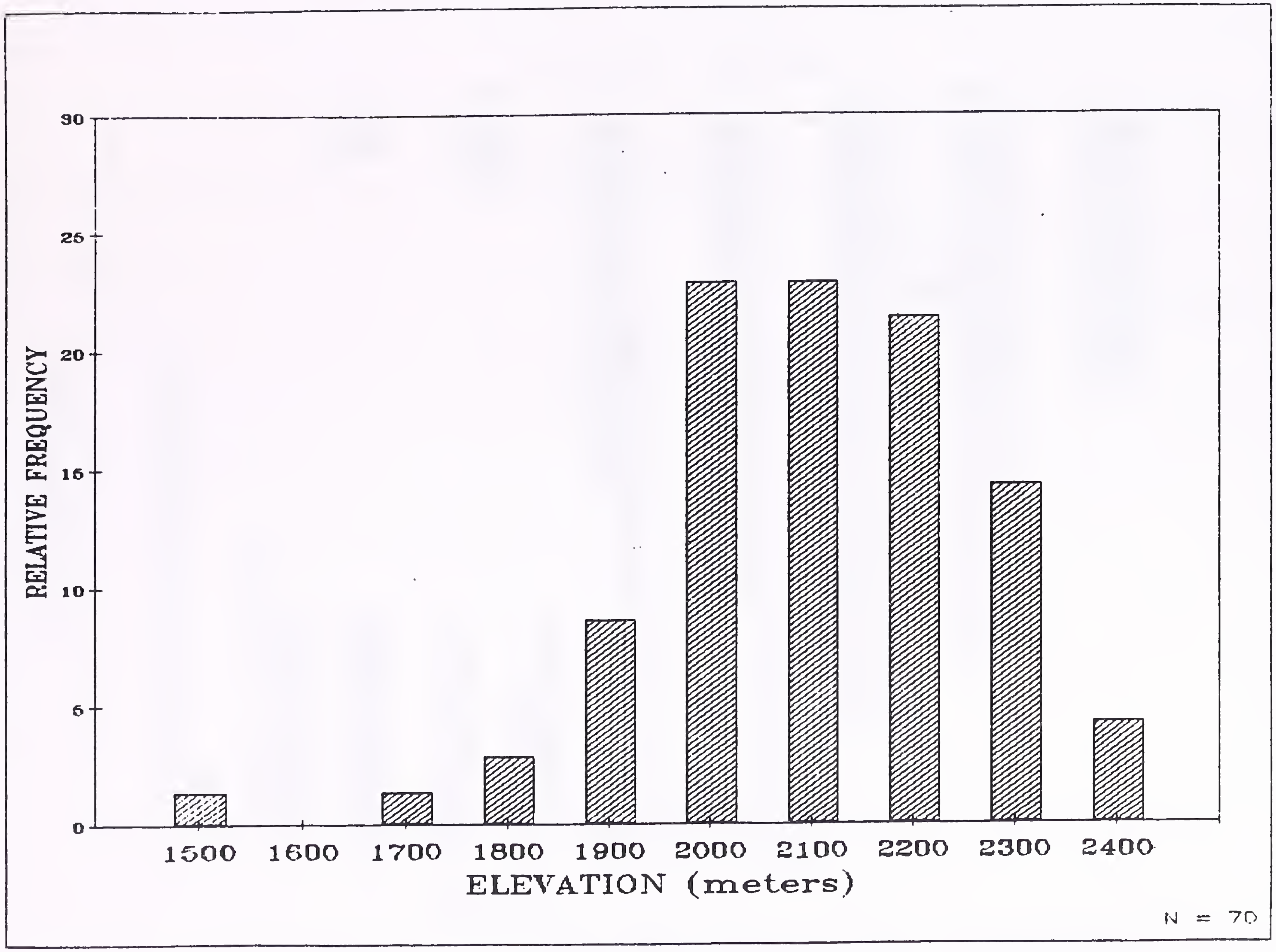


Figure 36. Elevation of grizzly bear dens.

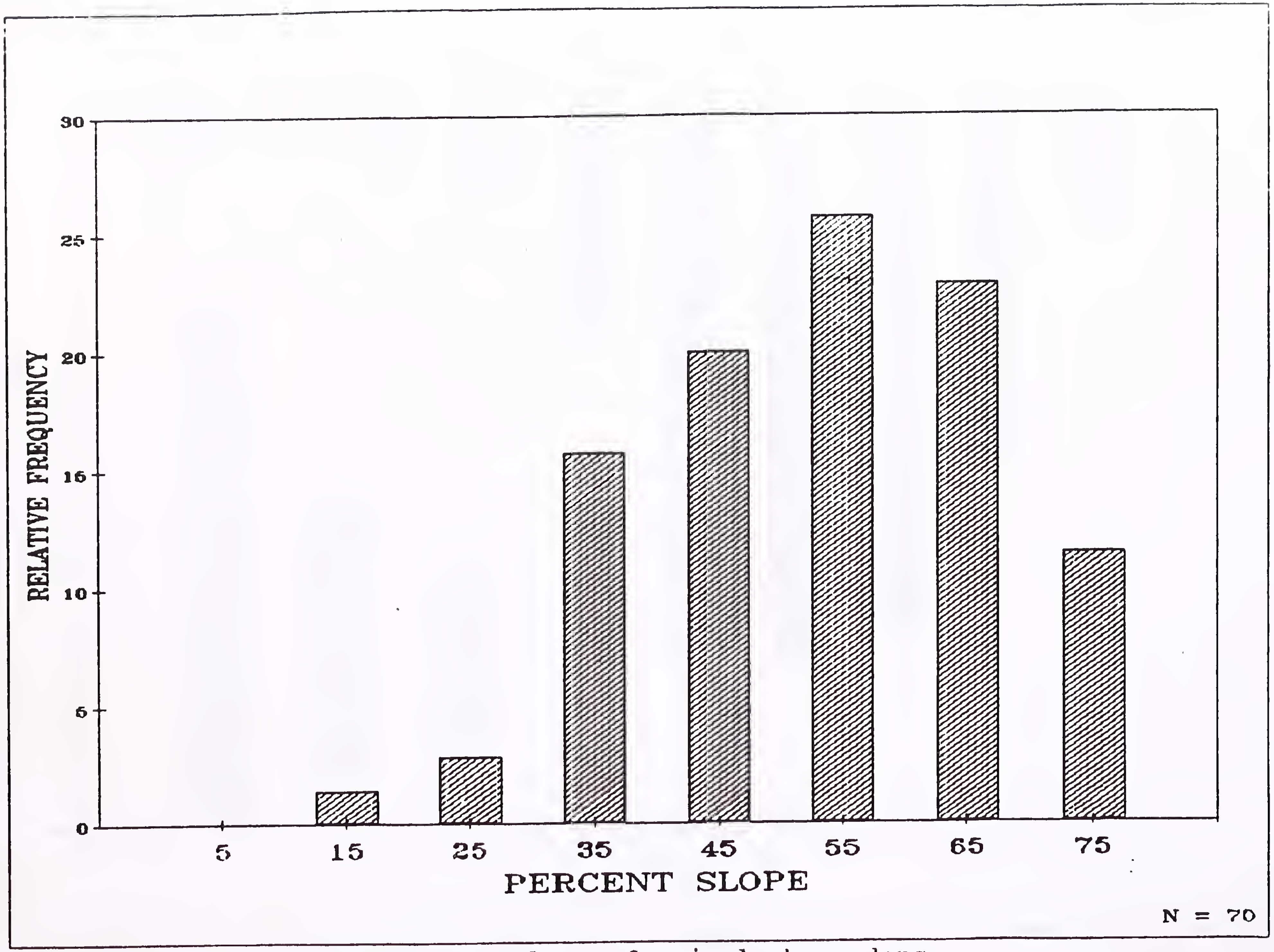


Figure 37. Slope of grizzly bear dens.

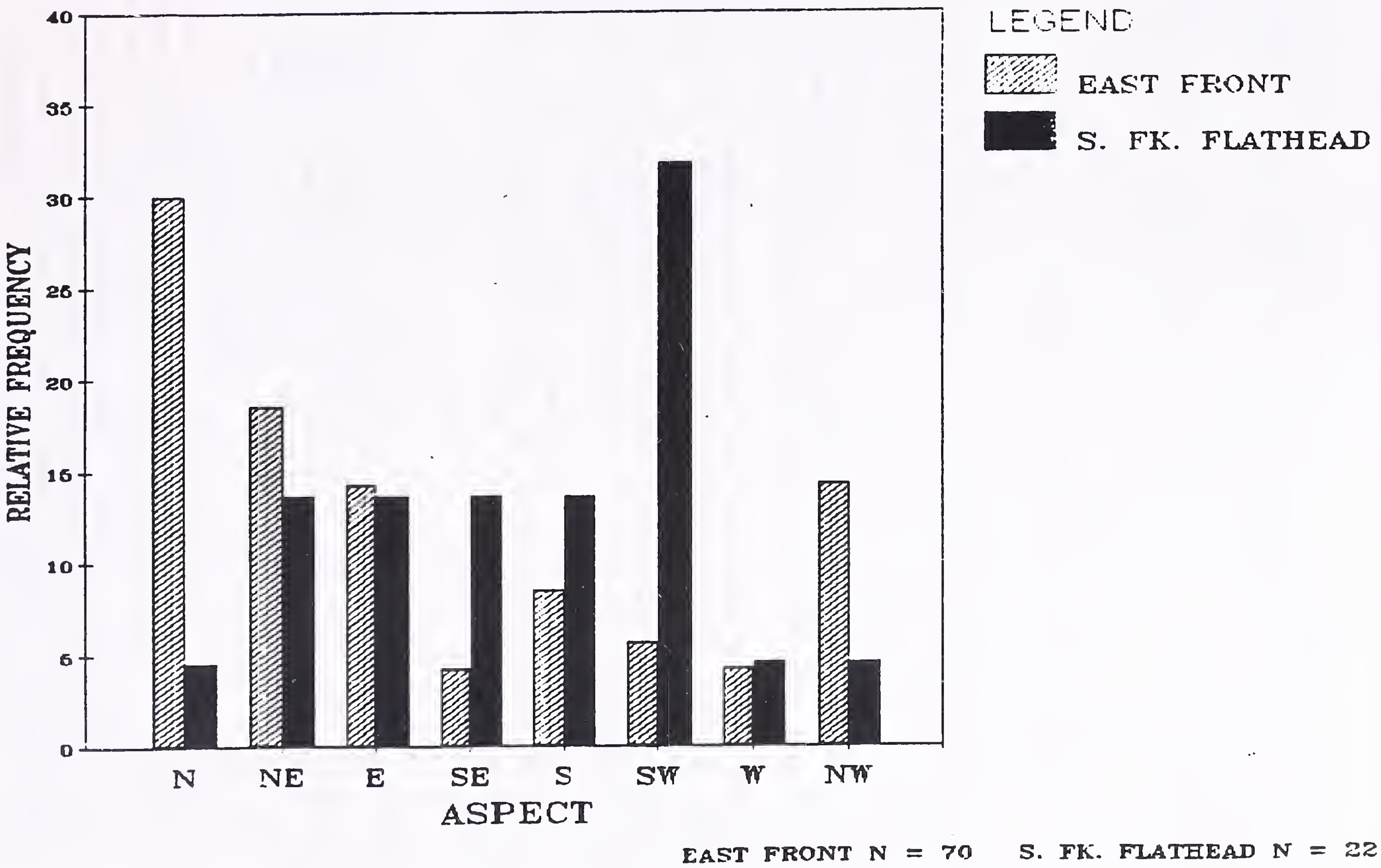


Figure 38. Aspects of grizzly bear dens from two study areas.

bear. Re-use of a denning area was observed frequently. In several cases we found dens of various ages within short distances of each other. In one particularly interesting case we found four dens within a 100 square m. area.

An unusual observation of a two-year old and a three-year old bear denning together was recorded. Both bears were independent and did not travel together throughout the year, however, they had made short term associations with each other. One was a male and the other a female. Both were located by radio telemetry in the same location late in the fall. Ground inspection revealed both bears denned in the same den. It is possible that the ages of these bears were in error and they were siblings but it was not known that they were related. A den of an older adult female from two years prior when she was accompanied by yearlings, was only about 100 yards up slope of this site.

We detected two occasions in which a female bear moved from one den site to a second during the winter denning period. In one case a female (273) relocated to a new den in February. We assume she transported cubs with her to this new site only 1/2 mile away. She was observed at each den site and helicopter flights over the area confirmed dens at each site. We hypothesized that the first den was deficient in some manner and was abandoned.

Den entrance dates for all grizzlies ranged between October 10 and December 5 with a median date of November 6 (N=45). Movement to dens occurred from October 6 to approximately December 1. Emergence dates ranged between March 10 and May 13 with a median date of April 7 (N=43). Bears in the Mission Mountains moved to dens between October 10 and November 20 and denned between November 2 and November 22 (Servheen (1981)). Den emergence occurred between April 12 and May 9, and den entrance between November 2 and November 26 in the South Fork of the Flathead River (Gillespie and Jonkel 1980).

Adult males, subadults, females with no cubs, and females with yearlings or two year-olds emerged from their dens (median=April 4) earlier than females with cubs (median = May 1). The average interval between den emergence and movement away from the den was 8.9 days. Females tended to remain near the den longer (10.1 days on average) than males (5.5 days).

Pregnant females entered their dens (median = November 4) slightly earlier than subadults and females with cubs, which entered on a median date of November 6. Adult males were the last to den (median=November 21). The interval between arriving at the den area and actual entrance to the den was 11.8 days. Pregnant females spent considerably more time near the den before entrance (averaged 17.3 days) than adult males, subadults, or females with cubs. No difference was noted for the average interval before den entrance between males and females which were not pregnant.

Breeding areas and chronology

Courtship associations were monitored and plotted on maps to determine if specific regions or areas were selected for breeding activities.

Thirty eight courtship associations of bears were observed from April 21 to July 15, 1980-87. All but six of these courtship associations were recorded by radio telemetry. A total of 57 paired bears were observed in these courtship associations including multiple sightings of a single pair. The peak of pairing and most probably breeding activity is in late May with possibly a second pulse of activity in mid June (Figure 39).

Craighead et al (1969) and Craighead and Mitchell (1982) reported the start of the breeding season from May 26 to June 12 and lasting about 26 days. They report most of the observed copulations were in early June. Our data indicated that breeding activities could start earlier but peaked about the same time as the Yellowstone grizzly bears.

The observed duration of these association varied from one to 19 days. The mean duration of an association resulting in a pair bond was 8.2 days (N=20). In most cases radio monitoring intensity was insufficient to determine the actual duration of the association. Our assumption is that the durations of these recorded associations was probably underestimated. Murie (1981) reported that in Denali, the duration of pair bonds ranged from one week to 23 days. Other research indicates that opportunity breeders may associate with females for brief periods but not actually tend a female (Hornocker 1962 and Egbert 1978).

Male grizzlies consorted with more than one female. We observed several males breeding with two or more females in one spring period. In addition we observed females consorting with more than one male during the breeding season. We did record cases of more than one radio collared male bear near a female during the breeding season. Observations of males consorting with more than one female are provided by Hornocker (1962), Murie (1981), Dean (1976), and Modafferi (1984). Craighead et al (1969), Hornocker (1962), Murie (1981) and Modafferi (1984) observed females consorting with more than one male and in some cases two males at the same time. In one particularly unusual case we observed two adult females with a single male. The male and one female (500) were copulating while the second female (548) was less than 50 m. away observing. Both females were radio collared.

Data from these associations has shown that all spring range could potentially be used for breeding activities. In addition some female bears appeared to select remote areas which are not within the boundaries of traditional spring range. Bears such as 301, 257, 335 and unmarked females were observed in high elevation

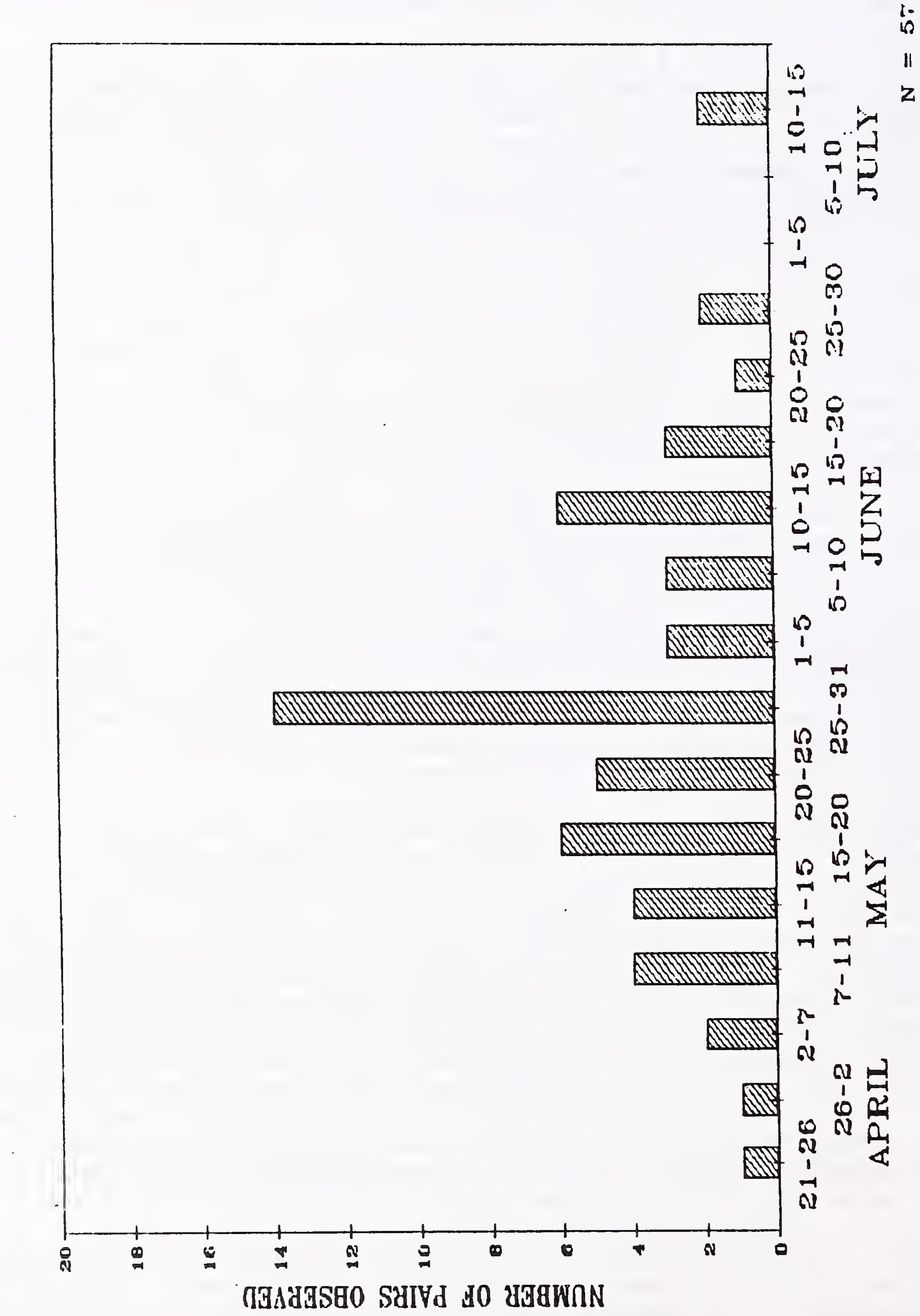


Figure 39. Courting grizzly bear pairs.

subalpine/alpine areas with males during mating. Use of these sites may be a result of the males hazing the females into such areas for seclusion to avoid competition from other males.

Impacts of Oil and Gas Activity

Oil and gas exploration activities began on the study area in 1979. Prior exploration had been conducted in the 1950's but the activities were abandoned and from the 50's until 1979 limited exploration activities were conducted.

At least 27 exploration wells were drilled within grizzly bear habitat along the front from 1979-87 (Figure 40). In addition over 1200 km. of seismic exploration was conducted within or near the National Forest along the Rocky Mountain Front (Figure 40). Records from these activities were kept as accurately as possible, however, prior to 1981 accurate records of seismic activity were not available. As a result, we were unable to analyze seismic activities prior to 1981 in relation to grizzly bear activities.

The level of exploration activities within grizzly bear habitat varied greatly until 1985 when the falling price of crude oil reduced the incentive to work in wildcat areas such as the Rocky Mountain Front. After this economic downturn, opportunities to monitor bears in relation to exploration activities were reduced.

From 1980-1984 opportunity existed to monitor some impacts of oil and gas exploration activity on grizzly bears. The primary focus of the effort was monitoring bear use at the Blackleaf natural gas field which was discovered and developed between 1980-84, and the various seismic operations being conducted within bear habitat between 1982-85.

A specific examination of the impacts of roads associated with oil and gas activities was not conducted. In general roads are a product of various activities, therefore, results pertaining to the influence of roads on grizzly bears are presented in a separate section of this report. The main emphasis of this section is to examine the activities specifically attributable to oil and gas exploration activities monitored during the study.

Aune and Stivers (1982) hypothesized that oil and gas activities associated with the development of the Blackleaf natural gas field might affect the distribution of grizzly bears within the field. Early examination of the data indicated that mean distance to roads, water, ranches, and oil/gas well sites increased, comparing the year before the exploration and the year of exploration (Aune and Stivers 1983). They concluded that gross distribution of random radio locations will not adequately address the issue of impacts by the activities.

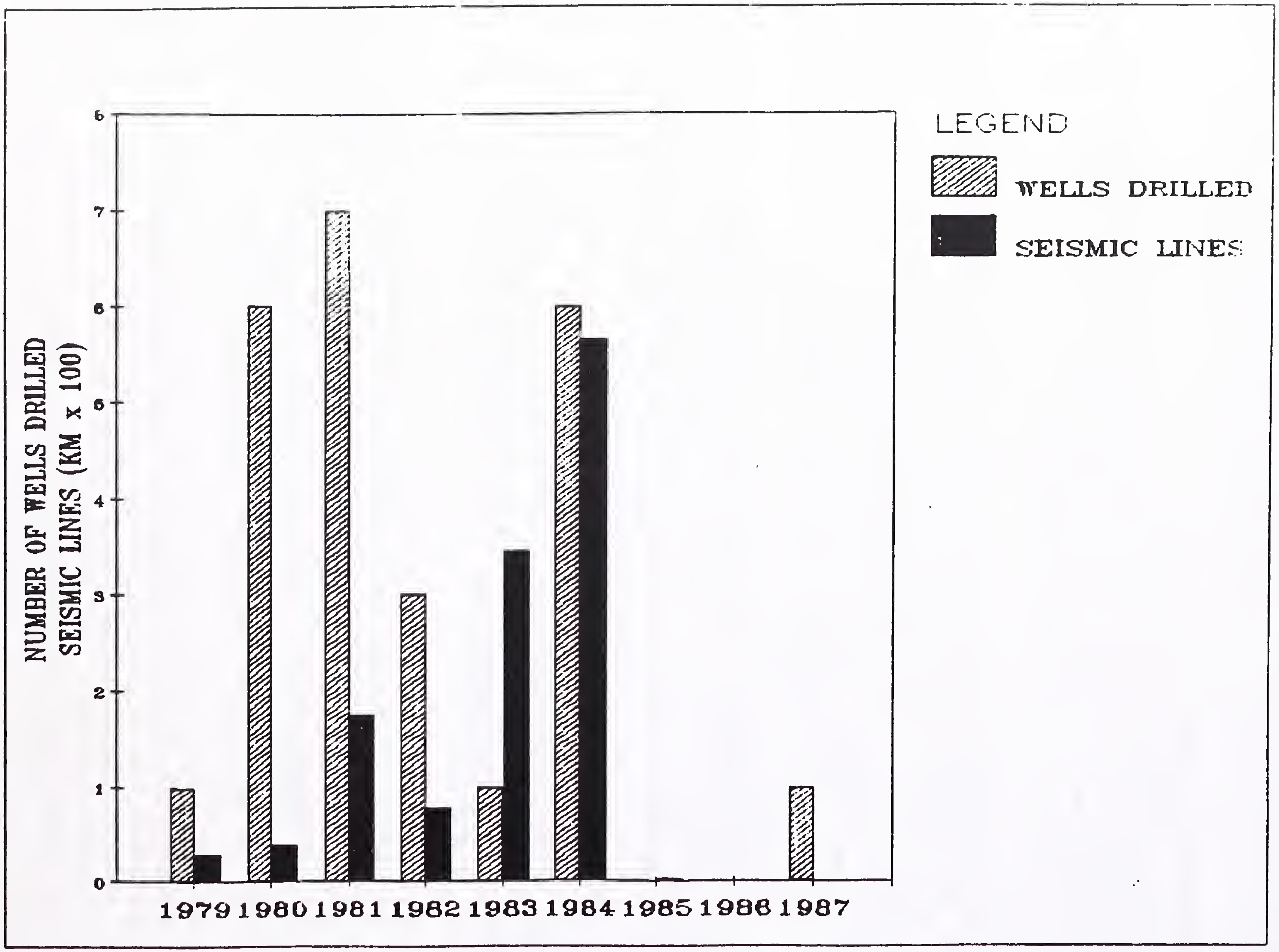


Figure 40. Oil and gas exploration activity.

Aune and Stivers (1982) hypothesized that oil and gas development may influence home range size and shape by causing shifts away from these development activities. Tests were conducted to determine if oil and gas activity might influence home range or seasonal range activity centers. Shifts in the geometric activity centers of two female grizzly bears exposed to the influences of the Blackleaf gas field were examined and compared to shifts in three female bears not influenced by the gas field development.

The distance in km. between two GAC's is termed the fidelity index value and reflects the shifting of activity centers between two or more years. The shift in GAC's of annual home ranges of five female grizzly bears ranged from 0.5-11.74 km. and averaged 5.68 km. Fidelity index values for bears impacted by the development activities around the Blackleaf natural gas field showed no significant difference ($P<0.05$) from index values of bears not influenced by the activities either annually or seasonally (Table 30).

Table 30. Fidelity index values from five different female grizzly bears, 1977-85, before, during, and after oil and gas exploration activities.

	Shift in geometric activity centers (km.)							
Bear no.	Annual	S.D.	Spring	S.D.	Summer	S.D.	Fall	S.D.
220*	7.0	2.7	7.1	3.1	8.9	5.4	9.5	4.9
257*	4.8	2.8	4.9	1.9	6.6	3.3	10.0	6.6
335	4.6	2.4	6.8	2.5	4.3	2.4	5.0	1.7
273	4.6	2.3	5.6	2.3	5.8	3.1	11.6	9.9
500	7.4	3.0	8.0	3.4	5.6	2.8	10.9	4.5
Mean	5.7		6.5		6.2		9.4	

* Indicates a bear using habitat within the Blackleaf natural gas field.

Fidelity index values for all bears were similar for the spring and summer seasons but all increased during the fall. The geometric activity centers for all bears was most variable during the fall period and the least variable during the spring. These data suggest that bears have a higher fidelity to specific spring ranges while during the fall considerable changes may occur in ranges and movements.

Annual home range size of two female grizzly bears affected by the development of the Blackleaf natural gas field were compared to home range sizes of three female grizzly bear not affected either in time or space but from a similar geographic area (Table 31).

An AOV analysis indicates that there was no difference ($P<0,05$) in the mean annual home range of all 5 bears examined. In addition AOV analysis indicates no difference ($P<0.05$) between years for two bears impacted by oil and gas activities and a slight increase in home range size for the three bears not impacted from 1977-87.

Table 31. Comparison of annual home ranges for five female grizzly bears, 1979-85, before, during, and after oil and gas exploration activities.

	Minimum annual home range (km^2.)				
Year	220 *	257 *	335	273	500
1979	492	-	-	-	-
1980	448	368	-	-	-
1981	451	332	373	334	-
1982	453	510	287	332	-
1983	736	466	404	360	311
1984	-	174	435	422	559
1985	-	-	-	-	622
1986	-	-	-	-	422
Mean	516	370	375	362	479
S.D.	124	131	64	42	139

* Grizzly bears using habitat within the Blackleaf natural gas field.

Data to this point suggest that oil and gas activities of the level experienced by these bears did not cause them to be displaced from annual home ranges (Figures 41 and 42). Both bears affected by the exploration and development activities appeared to shift activity centers and seasonal ranges in response to reproductive status and seasonal food availability.

Grizzly bears do appear to be displaced from areas around individual drill sites (Aune et al 1984). Monitoring of grizzlies in the Cow Creek area in 1980-83 has indicated a temporary displacement around a well site during drilling (Figure 43). An area of 0.8 km. (0.5 mi.) radius which had been used by grizzlies prior to the exploration was not used during the activity but was used by grizzlies after drilling activities had ceased and the well was developed.

Sample sizes in the data are small and further examination of site specific impacts of well drilling should be conducted. We were unable to encounter a situation with study potential after oil and gas activities decreased on our study area. Many variables at each site such as habituation to the activity and topographic/vegetative

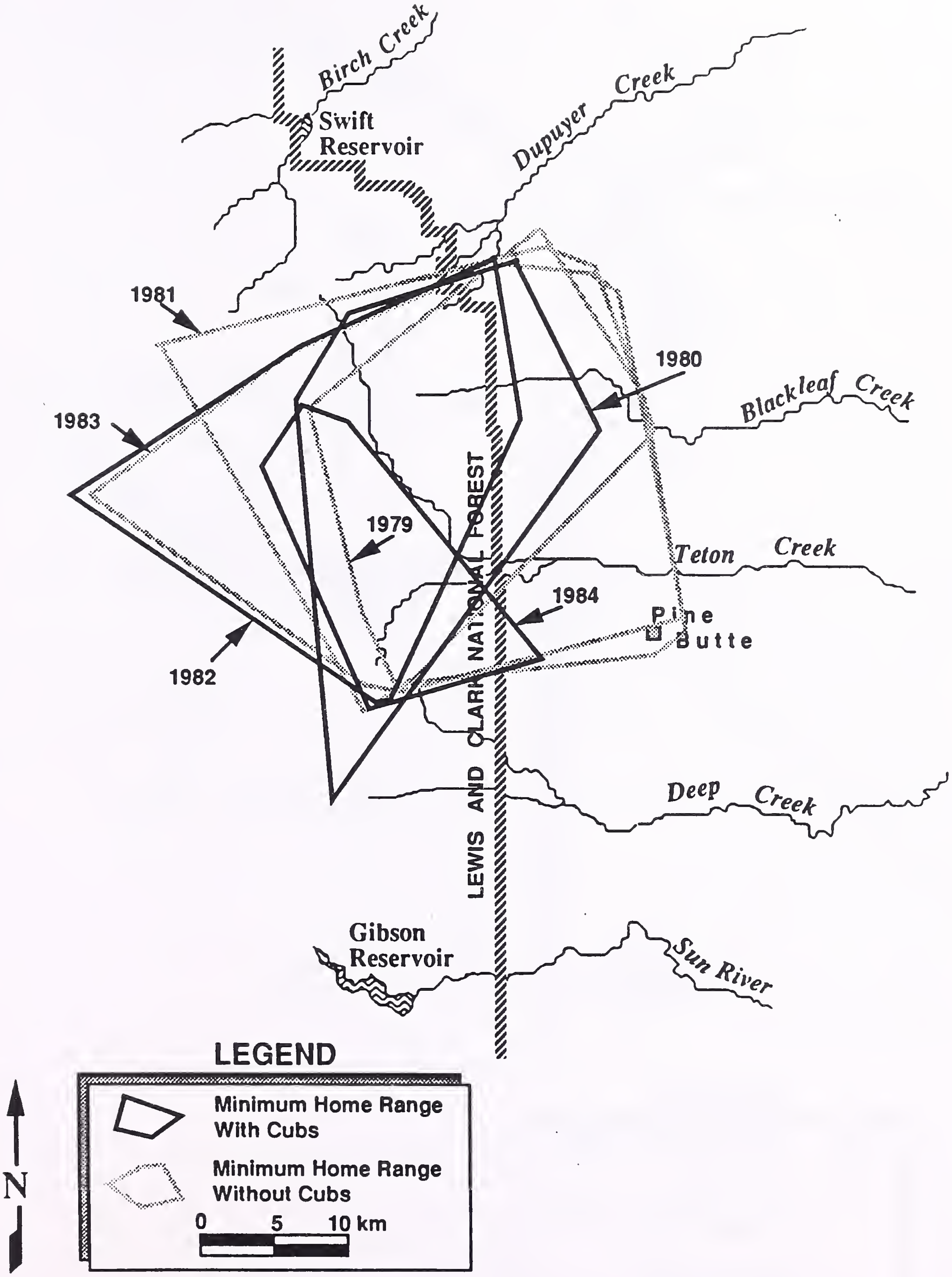


Figure 41. Annual home ranges of grizzly bear 220 before, during and after the exploration of the Blackleaf Natural Gas Field.

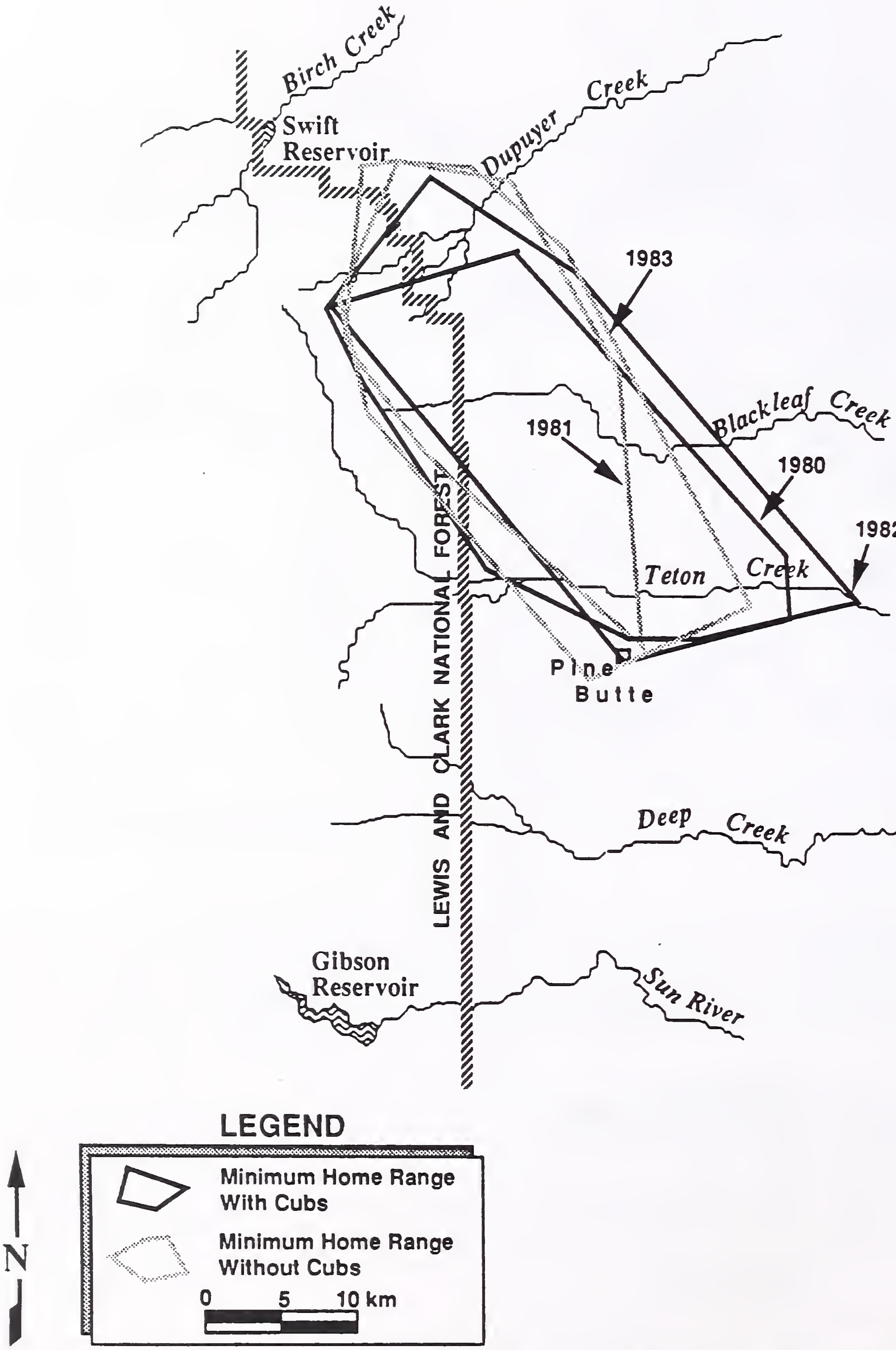


Figure 42. Annual home ranges of grizzly bear 220 before, during and after the exploration of the Blackleaf Natural Gas Field.

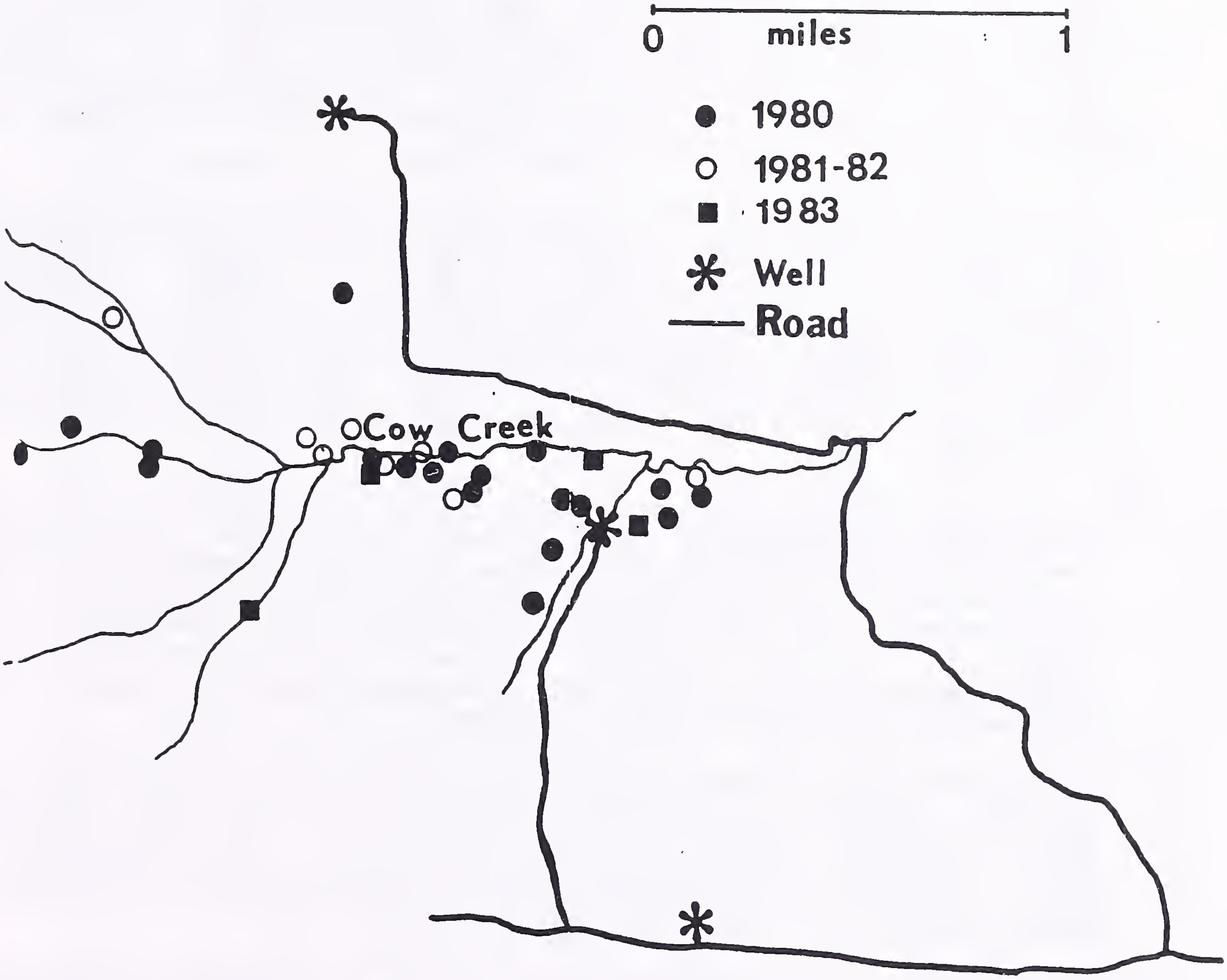


Figure 43. Comparison of grizzly bear radio fixes before, during, and after the drilling and development of Section 5 well on the Cow Creek drainage 1980-83.

screening could affect the potential for displacement. These variations would require a large sample of case studies in various settings for proper conclusions.

In our study area, existing guidelines preventing development in prime habitat and mitigation stipulations on activities limited the opportunity of this study to examine impacts associated with the drilling for oil and gas. Where we had sufficient data and radio collared grizzlies, exploration could not or did not occur. Where radioed bears were not present or data was limited, exploration was allowed or encouraged. Our studies do suggest that the guidelines promoting spatial separation of exploration and bear activities were apparently successful.

Our conclusion is that oil and gas drilling activities of the level experienced in the study area did not cause major perturbations in the movements and activities of grizzly bears. Temporary displacement of bears around a drill site, however, may occur. Harding and Nagy (1980) also concluded that grizzlies did not avoid the general area of industrial activity, but did avoid the area within 1 km. of drill sites, camps, etc. They concluded that in Canada the grizzly population had apparently adapted to existing facilities.

Guidelines promoting the separation of drilling activities and bear activities accomplished their intent during the study period. These studies do suggest that larger scale developments could have a potential to displace bears and sufficient disturbance could force changes in bear ranges or increase the vulnerability to mortality. During this study, few new roads were developed along with exploration and activity levels were moderate to low compared to a major oil and gas field discovery.

We examined seismic exploration activities in relation to bears in 1983-85. Most of the seismic surveys conducted along the front were helicopter supported programs using a surface charge to measure seismic response of the subsurface. Occasionally porta-drill, Vibrosies, or Magneto-Telluric techniques were applied to survey operations along the front.

During the study we examined data for time and space relationships of grizzly bears and seismic activity. In addition, we conducted specific case studies monitoring activities of bears and seismic activities. For our examination of the spatial distribution of bears in relation to seismic activities we were able to evaluate the impacts associated with six major projects potentially affecting ten different grizzlies. Nine specific case studies were conducted at nine different locations (Appendix E).

During six major seismic survey operations we were able to obtain 120 radio locations from 10 grizzly bears and to measure the distance to the nearest active portion of the seismic project

(Figures 44, 45, and 46). The average distance to an active portion of a seismic project was 10.3 km. and ranged from 0.6 to 28.8 km. (Table 32). Eighty one percent of the locations in the data file were more than 3.22 km. (2 mi.) from an active seismic line.

Table 32. The distance (km.) to the nearest seismic activities for 10 grizzly bears on the Rocky Mountain Front, 1983-85.

Bear no.	Age	N	Year	Mean	Range	S.D.	Percent > 3.22 km.
335	5.5	14	83	10.6	3.0 - 28.8	7.8	93
257	13.5	7	83	11.4	2.5 - 19.9	6.6	71
220	22.5	15	83	7.0	0.6 - 15.9	4.1	80
518	2.5	7	83	15.1	13.1 - 16.1	2.0	100
548	11.5	4	83	14.1	6.8 - 23.8	7.1	100
500	4.5	5	83	12.4	10.3 - 23.6	5.4	100
366	5.5	27	84	6.6	0.8 - 10.1	2.5	74
544	4.5	23	84	8.1	1.6 - 13.4	3.3	74
313	3.5	4	84	13.8	3.6 - 20.1	7.1	75
485	8.5	9	84	9.8	4.0 - 15.3	3.6	89
366	6.5	5	84	4.4	1.8 - 6.5	1.9	60
		120		10.3	0.6 - 28.8		

Of the nine case studies two involved close range encounters (< 1 km.) between seismic activity and resulted in a clear example of bears being displaced by the activity. The remaining seven cases involved monitoring bears at distances ranging from 1.2-6.4 km. from the activity. At greater distances movements of bears were generally away from the disturbance with the exception of one case where a young subadult preying upon sheep remained within the activity zone. At ranges 4-6 km. changes were detected in activity collars in what appeared to be response to seismic blasts. Aircraft flying within 1 km. of the bear caused reactions in bears wearing activity sensitive collars. Specific instances of bears reacting to vehicles and aircraft were noted in several of the case studies.

Results indicate that the primary impact of seismic activities on the grizzly bears monitored was the temporary displacement of bears away from the surface blasting. McLellan and Mace (1985) examined the effects of seismic exploration on grizzly bears in Canada. They report that responses to several activities varied but concluded that there was no indication of avoidance of seismic activity in some cases and an avoidance of a 500 m. zone during

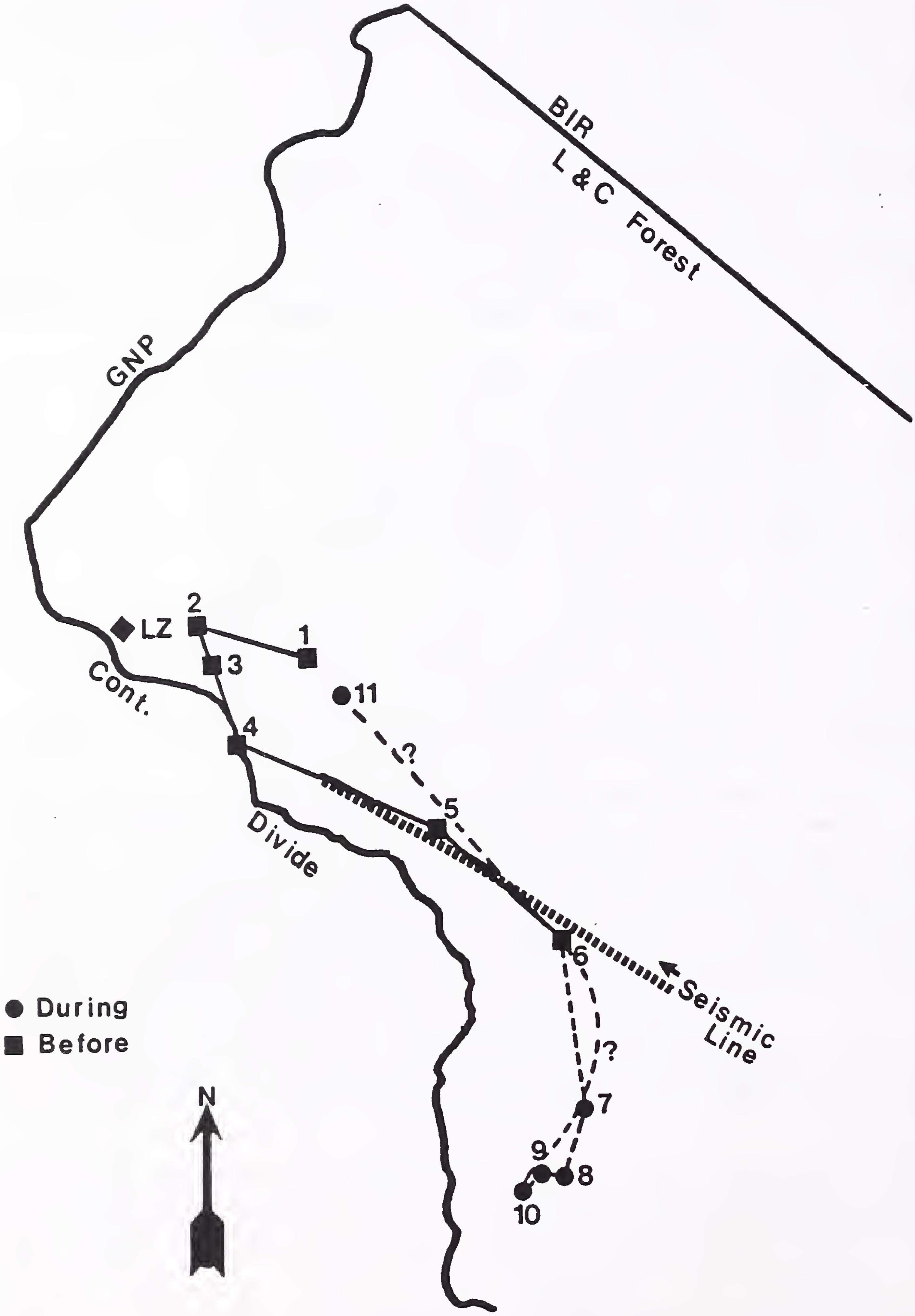


Figure 44. Movement of grizzly bear 366 in relation to seismic activity, 1985.

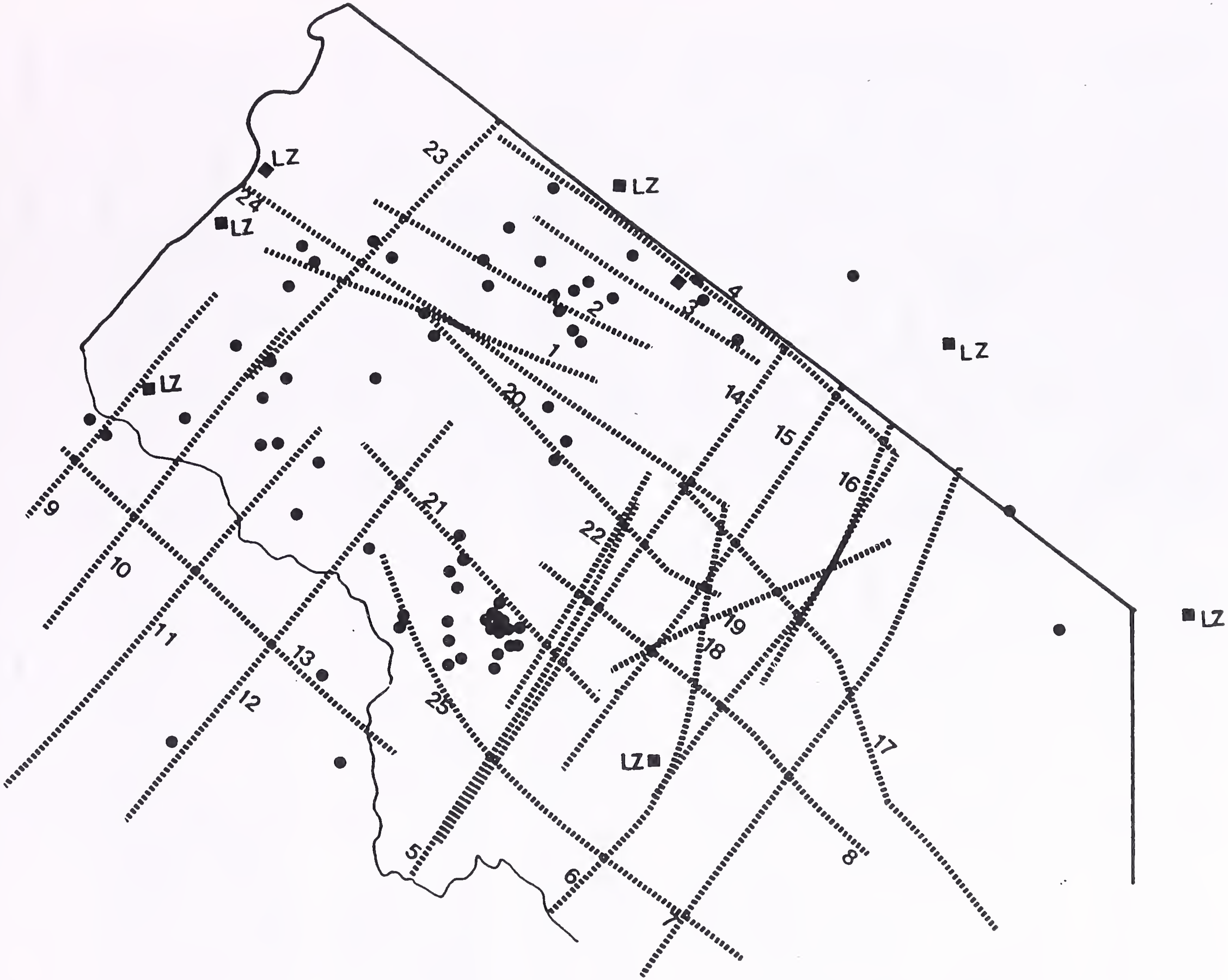


Figure 45. Distribution of grizzly bears in relation to the 1984 seismic project in the Badger-Two Medicine area.

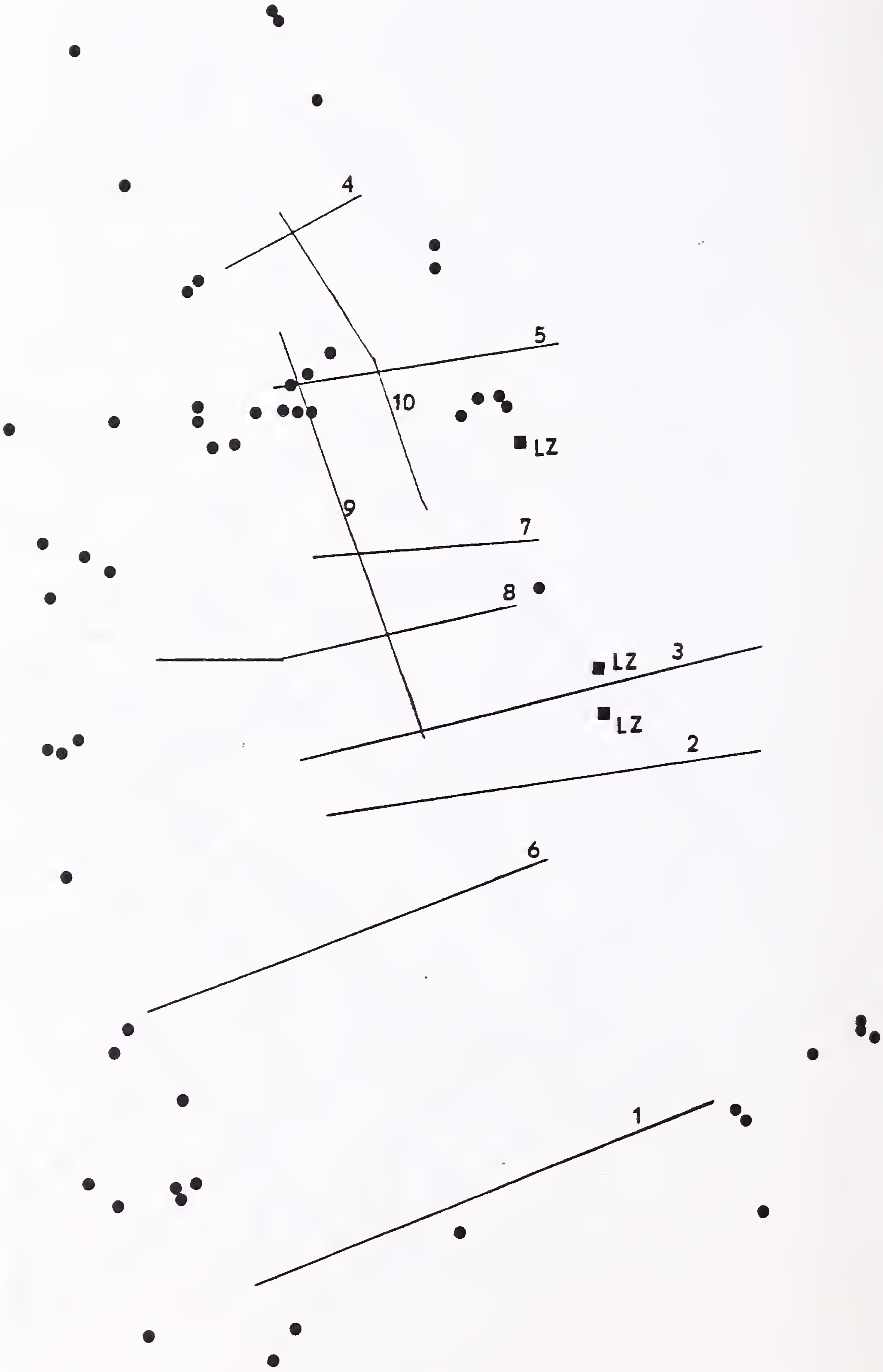


Figure 46. Distribution of grizzly bears in relation to the SOHIO seismic project conducted August through October, 1983.

the disturbance in other cases. Their study area is heavily impacted by roads and logging activity while our study area is mostly roadless and semi-primitive with little activity other than livestock grazing. It is probable that many east front bears have not habituated to vehicle, aircraft, and human activity.

In at least one case study it appeared that one grizzly bear left the drainage at the onset of preliminary activities while another waited for blasting to occur before being displaced. Activity monitoring conducted during survey operations indicated that although some bears may not be displaced from seismic activity they were exhibiting unusual activity patterns. In several case studies, the type of movements and activity patterns observed indicated that bears were agitated by some of the activities. These observations indicate that individual grizzlies varied in their response to seismic activities. There may be varying tolerances to this type of activity by individual bears depending upon past associations with man's activities, sex, age, and reproductive status. Our data sample was not large enough to discern the influence of these parameters on bear response to seismic exploration.

The seismic programs we observed were regulated by a nine mile spacing restriction and provided sufficient activity-free zones for bears to move into and forage freely. We observed bears and radio monitored bears within these activity-free zones and detected little abnormal activity patterns.

There was some subjective evidence that at least some bears were gradually habituating to the seismic activities within the study area. One adult female (366) monitored during repeated exposures to seismic exploration seemed to decrease the intensity of reactions to the activity. By the completion of the summer this bear would tolerate seismic blasting within the same drainage.

No seismic activity occurred within denning habitat during our study. We did not detect any den abandonment related to this activity. Reynolds et al (1984) found bears in Alaska did not abandon dens due to seismic explosions, however, showed signs of agitation within the den. Harding and Nagy (1980) found that grizzlies on Richards Island, Northwest Territories, denned within the 1.6 km. of active hydrocarbon exploration. They did report one den abandonment caused by a seismic vehicle and another by a gravel mine.

Impacts of Roads

To examine the impacts of open roads on grizzly bears we conducted a use/availability analysis on data for the region from Sun River to Birch Creek (Figure 47). Open roads included all roads with no vehicle restrictions, mapped on USGS quad maps for the study area. All new or upgraded roads were added to the map base to complete the open road inventory. From 1249 aerial radio locations we calculated a distance to the nearest open road and compared these distances to a sample of 5673 random points. Only aerial radio location data from the years 1977-87 were utilized to avoid bias toward roads inherent with ground locations.

The mean distance to roads for all bears radioed during the study was 3167 m.. Mean distance gradually increased from spring to fall (Table 33). The increase from spring to summer was not significant ($P<0.05$) though the summer to fall increase was significant. An examination of distance from roads by week indicated that during the month of May bears were closest to roads with the mean distance gradually increasing until denning (Figure 48).

Table 33. Mean distance from roads for 2633 grizzly bear radio relocations, 1977-87.

Season	N	Mean	95% C.I.	Homogenous groups
Spring	423	2267.8	1843.3-2692.2	*
Summer	426	2603.6	2180.6-3026.5	*
Fall	400	4720.7	4284.2-5157.1	*

An AOV was conducted on distance to road data for the core area by sex and age classes (Table 34). Females were found closer to roads than males. Adult males were located significantly farther from any open roads than all other sex and age groups. We did not have sufficient sample size in all sex and age classes to examine seasonal differences.

Table 34. Comparisons of mean distance to roads for sex and age classes on the Rocky Mountain Front core area, 1977-87.

Class	N	Mean (m.)	95% C.I.	Homogeneous groups
Subadult female	136	1949.4	1326.3- 2572.5	*
Adult female	823	2254.6	2001.3- 2507.9	*
Subadult male	165	2894.2	2328.5- 3459.9	*
Adult male	112	10184.3	9497.7-10870.9	*

Before conducting the use/availability analysis we reviewed grizzly bear activities in relation to roads. AOV of bear activity in

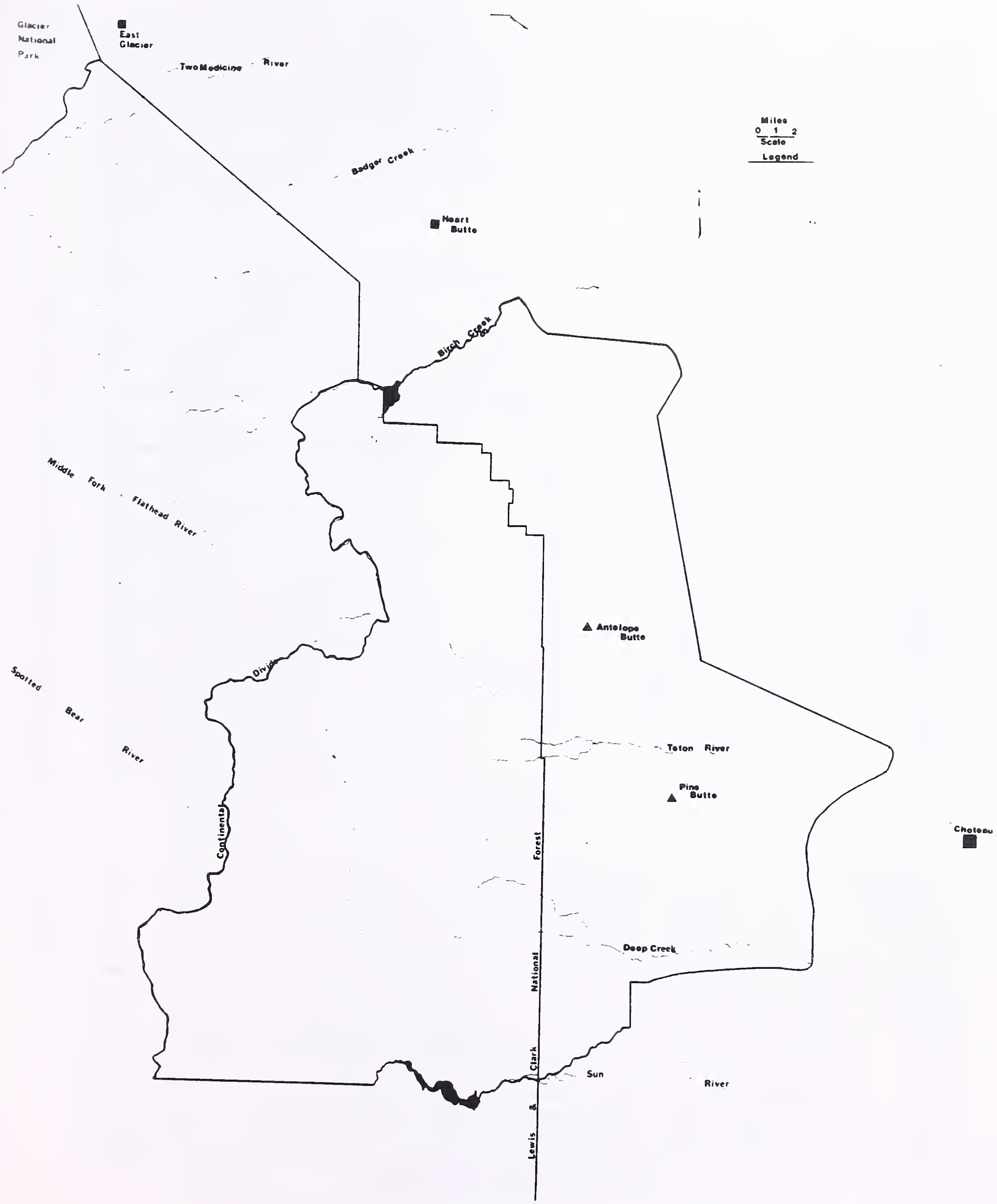


Figure 47. Area sampled for availability/utilization studies.

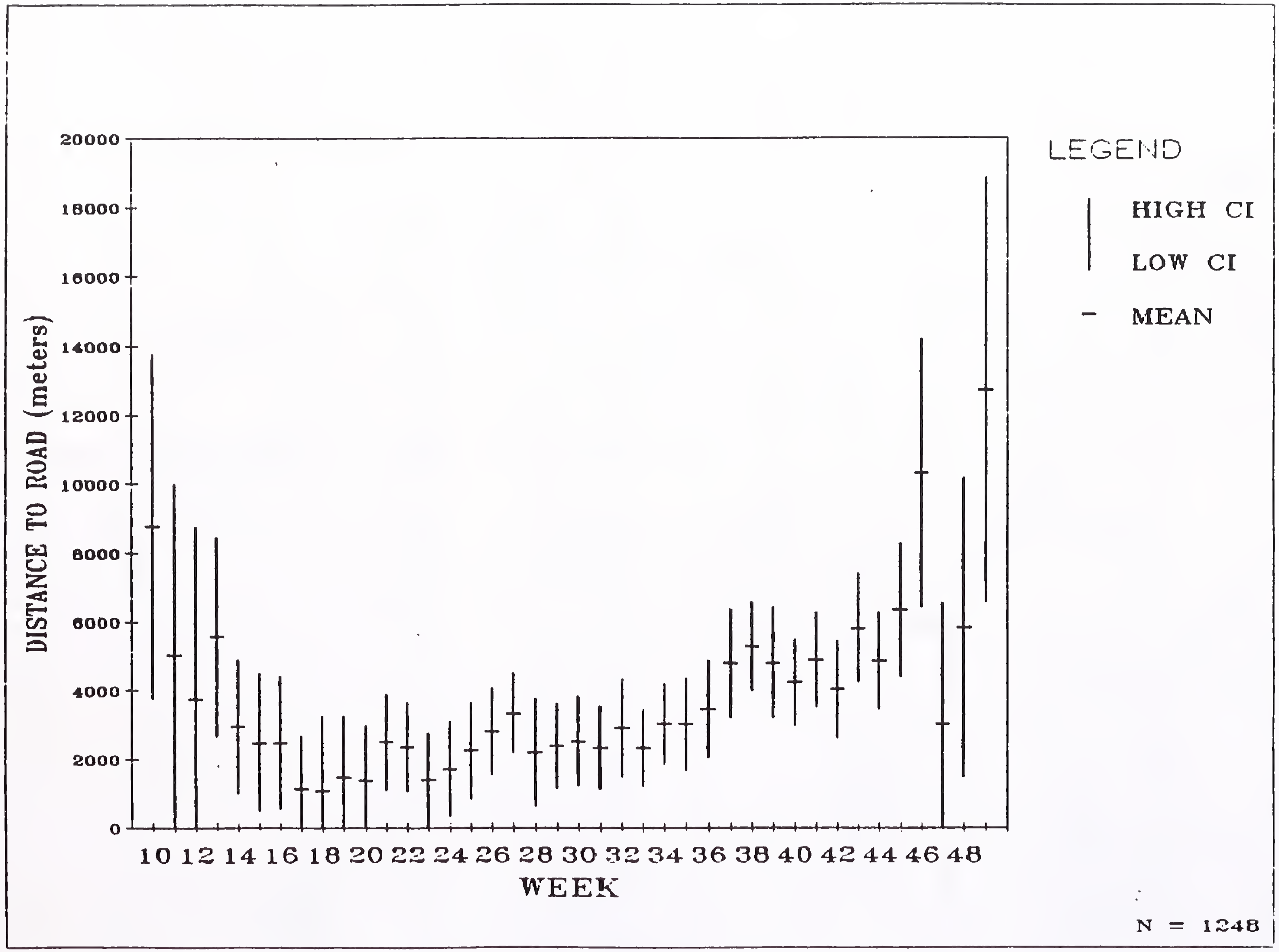


Figure 48. Grizzly bear distance to road by week.

relation to roads indicated that activities such as feeding at garbage dumps, insect feeding, grazing and feeding at carcasses were usually conducted within closer range of roads than berry feeding and bedding (Table 35). Pine nut digging, root digging, mating and denning activities occurred on average a considerable distance from roads. Many of these latter activities occur during the late summer and fall. Other activities were conducted within a wide range of distances.

Table 35. Grizzly bear activities in relation to their distribution to roads in the Rocky Mountain Front, core area, 1977-87.

Activity	N	Mean distance to roads (m.)	Homogenous groups
Anthropogenic foods (dumps)	1	427	*
Insect feeding (ants)	21	776	**
Grazing	28	961	***
Feeding on carrion	44	1414	***
Stripping bark	1	1433	***
Bedded	201	1557	****
Feeding on berries	45	1768	*****
Traveling	113	2372	******
Other feeding activities	28	3380	*******
Digging small mammals	29	3396	*******
Other non-feeding	8	3501	********
Unknown	532	3624	* * ***
Digging roots	56	4132	* * ****
Mating	19	4883	* * ****
Denning	83	5392	* * ** *
Digging pine nuts	39	6632	* * * *

Using the availability data we conducted an AOV for distance to roads for each component. The distribution of habitat components in relation to roads varied considerably (Figure 49). Riparian components essential for spring and used primarily for grazing forbs and grasses were found conspicuously nearer roads than other components. The more widely distributed components in relation to roads were sidehill parks, closed timber, open timber and timbered shrubfields. Many important foraging components used by bears were found closely associated with roads implying that bears based on habitat preference, should be distributed nearer roads especially during the foraging season. Other important components which produce fall foods were generally not close to roads implying that bears should be distributed further from roads during fall. The one exception to this is the lowland berry crops produced

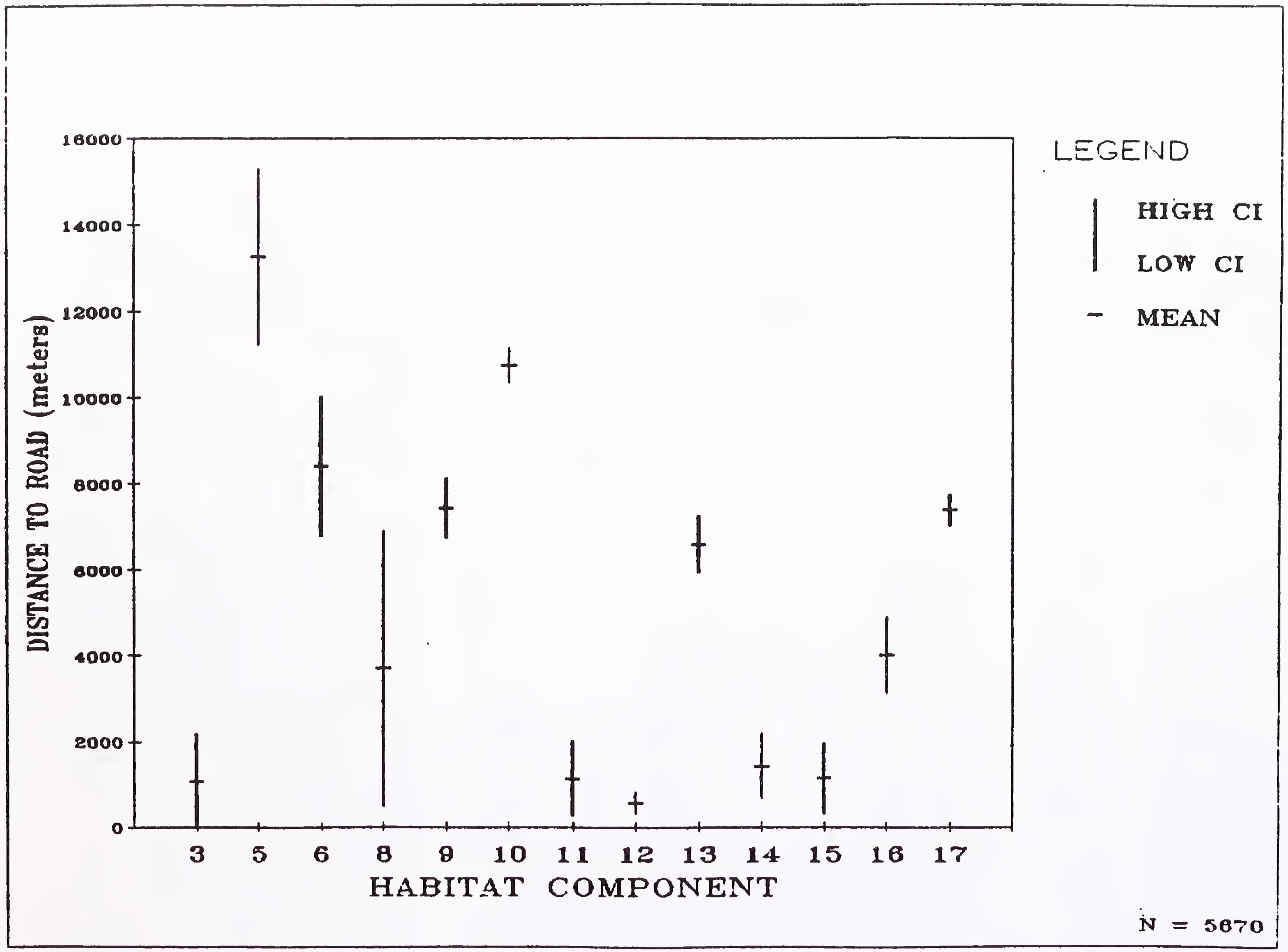


Figure 49. Mean distance to road by habitat component.

within the populus and riparian shrub communities. Thus, bears accessing these resources during the berry season may be found closer to roads in late summer and early fall.

Using the percent availability determined from random points and the frequency of radio relocations in each of eleven 500 m. distance zones we conducted a chi-square test to determine whether there is a significant difference between the expected and observed use by grizzly bears. A significant difference ($P<0.05$) was found between the use and availability of these zones. Habitat within 500 m. of a road was used significantly less than expected (Table 36). Seasonal analysis showed that grizzly bears used this zone significantly less than expected during spring and fall but only slightly less than expected during the summer. In the summer period berry feeding becomes important in lowland habitats, placing bears utilizing these resources closer to the roads.

Table 36. Avoidance and selection of habitat near roads along the Rocky Mountain Front core area, 1977-87.

Distance zone	Spring*	Summer	Fall	Total
0- 500	-	0	-	-
500-1000	+	+	0	+
1000-1500	0	0	0	0
1500-2000	+	0	0	+
2000-2500	0	0	0	0
2500-3000	0	0	0	0
3000-3500	0	0	+	+
3500-4000	0	+	+	+
4000-4500	0	0	0	+
4500-5000	0	0	0	0
5000 +	+	-	0	-

* equals avoidance
+ equals preference
o equals proportional

These results indicate that bears may be displaced within 500 m. of open roads. We examined the use availability data further within this zone by analyzing use/availability in 100 m. zones to refine our displacement zone around open roads. Chi-square test indicated that use was not proportional to availability in these 100 m. zones. Simultaneous intervals for each zone indicated that bears used the zones within 300 m. less than expected although not always significantly (Table 37). Use was significantly less than expected in all three seasons within the zone 100 m. from the roads. Fall showed the strongest avoidance reaction but much of this may be explained by preference for important seasonal habitats which are located further from roads.

Table 37. Avoidance and selection of habitat near roads using 100 meter intervals for the Rocky Mountain Front core area, 1977-87.

Distance zone	Spring*	Summer	Fall	Total
0-100	-	-	-	-
100-200	-	0	-	0
200-300	0	0	-	0
300-400	0	0	-	0
400-500	0	0	0	0
500 +	+	0	0	+

- equals avoidance
+ equals preference
0 equals proportional

The radio location data used in this analysis consisted of bears with two different seasonal foraging strategies. Aune et al (1985) conducted use/availability analysis comparing these two bear groups and concluded that there was significant differences in the displacement zone of roads for these groups. We continued the use/availability analysis results comparing a lowland bear group (273, 257, and 500) and a backcountry bear group (220, 335, and 548). Each bear group preferred slightly different habitats and presumably differed in levels of habituation to road activity (Table 38).

Table 38. Avoidance and selection of habitat near roads along the Rocky Mountain Front core area by two different bear groups, 1977-87.

Distance zone	Lowland bears	Backcountry bears
0-100	-	-
100-200	0	-
200-300	0	-
300-400	0	0
400-500	0	-
500 +	+	+

- equals avoidance
+ equals preference
0 equals proportional

The data suggests that there were significant differences in the displacement of various bears within our study area. Lowland bears appeared to be avoiding the habitat within 100 m. of open roads whereas backcountry bears avoid the habitat as far as 500 m. from open roads. This difference is probably due to the habituation of individual bears to activity on roads and to some degree the difference in habitat preference by individuals.

HABITAT STUDIES

Bear Management Unit Constituent Elements

East front grizzly bear habitat was divided into six Biological Evaluation Units in 1984 (USDA). These units were modified in 1985 and constituent element maps were created for two evaluation units (Figures 50 and 51). These units were renamed Bear Management Units (BMUs) for better interagency communication (Young, 1986). Constituent element maps for the remaining four BMUs were created in 1986 (Figures 52-55).

Constituent elements were defined as spring, denning, summer, and fall habitats according to the U.S.F.S. (USDA 1984). Summer and fall habitats encompass the entire BMU in each unit. Therefore, constituent elements maps only provide specific information on spring and denning habits which are a portion of each BMU.

A total of 1756 km^2 (677.8 mi^2) of bear habitat were constituent element mapped in 1985. Four BMUs covering 2994 km^2 (1155.7 mi^2) were constituent element mapped in 1986. Almost all (99.4%) of the denning habitat occurs within the Lewis and Clark Forest (Table 39). In contrast over 60% of the spring habitat of grizzly bears is outside of the Lewis and Clark Forest. In only two BMUs does the proportion of spring habitat within the forest exceed the proportion outside the National Forest. The four other BMU's have 63.9 to 81.5% of the spring range outside of the National Forest.

Constituent element maps emphasize the important relationship between public and private lands along the front. This marriage of public and private lands to form a complete ecological land unit suitable for grizzly bears is more significant in some BMUs where a predominance of spring habitat is outside of the National Forest. For example the Teton-Birch Creek BMU has over 80% of its spring habitat outside of the National Forest. Distribution data of grizzly bears within this unit revealed the high value of these lands to bears within this BMU.

General Physical Characteristics of Habitats Used by Grizzly Bears

We examined the data from 2633 radio locations to determine if some gross physical characteristics could be considered of primary

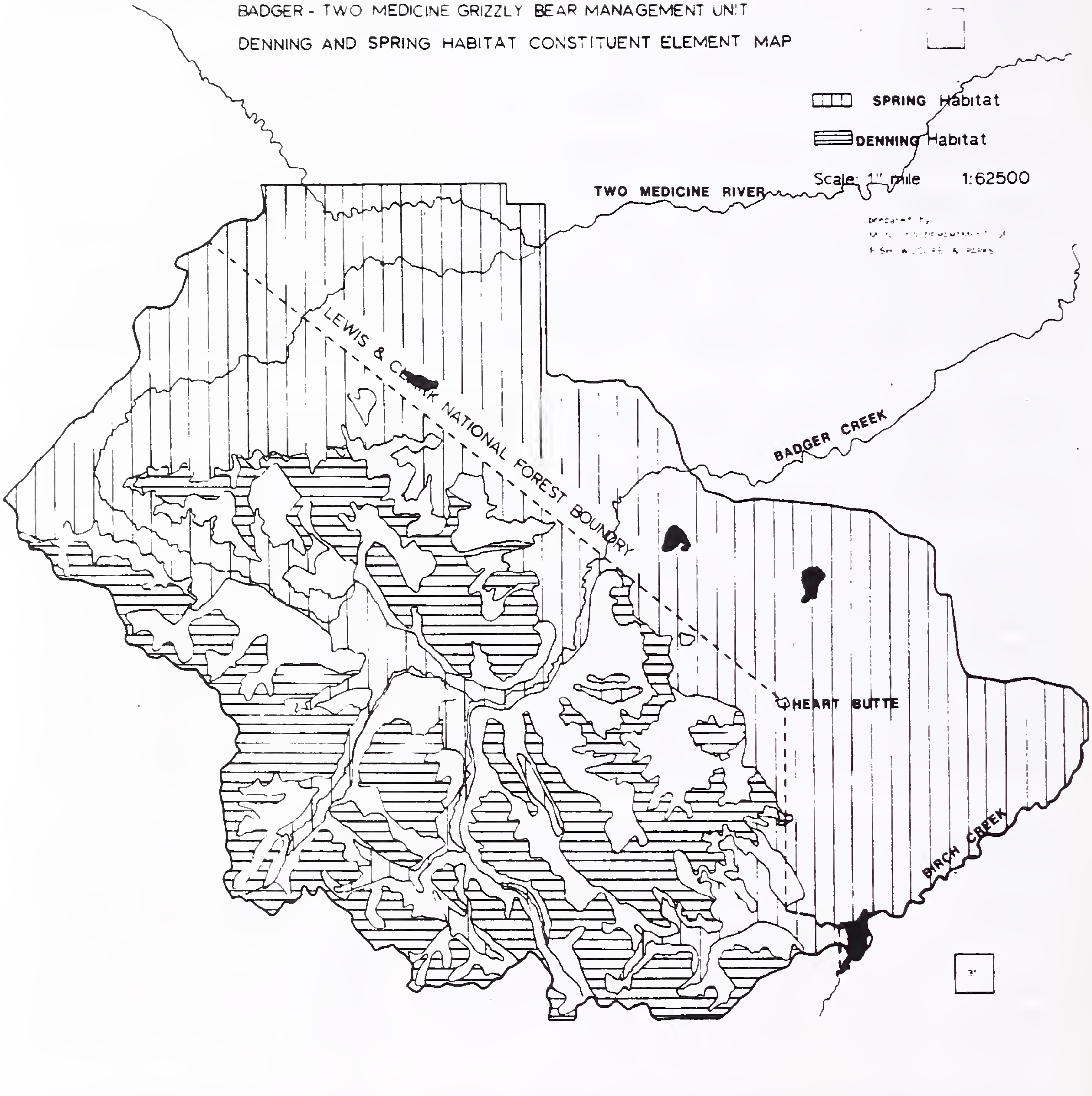

BADGER - TWO MEDICINE GRIZZLY BEAR MANAGEMENT UNIT
DENNING AND SPRING HABITAT CONSTITUENT ELEMENT MAP
SPRING Habitat
DENNING Habitat
Scale: 1" mile 1:62500
TWO MEDICINE RIVER
BADGER CREEK
LEWIS & CLARK NATIONAL FOREST BOUNDRY
HEART BUTTE
BIRCH CREEK

Figure 50. Constituent element map, 1986.

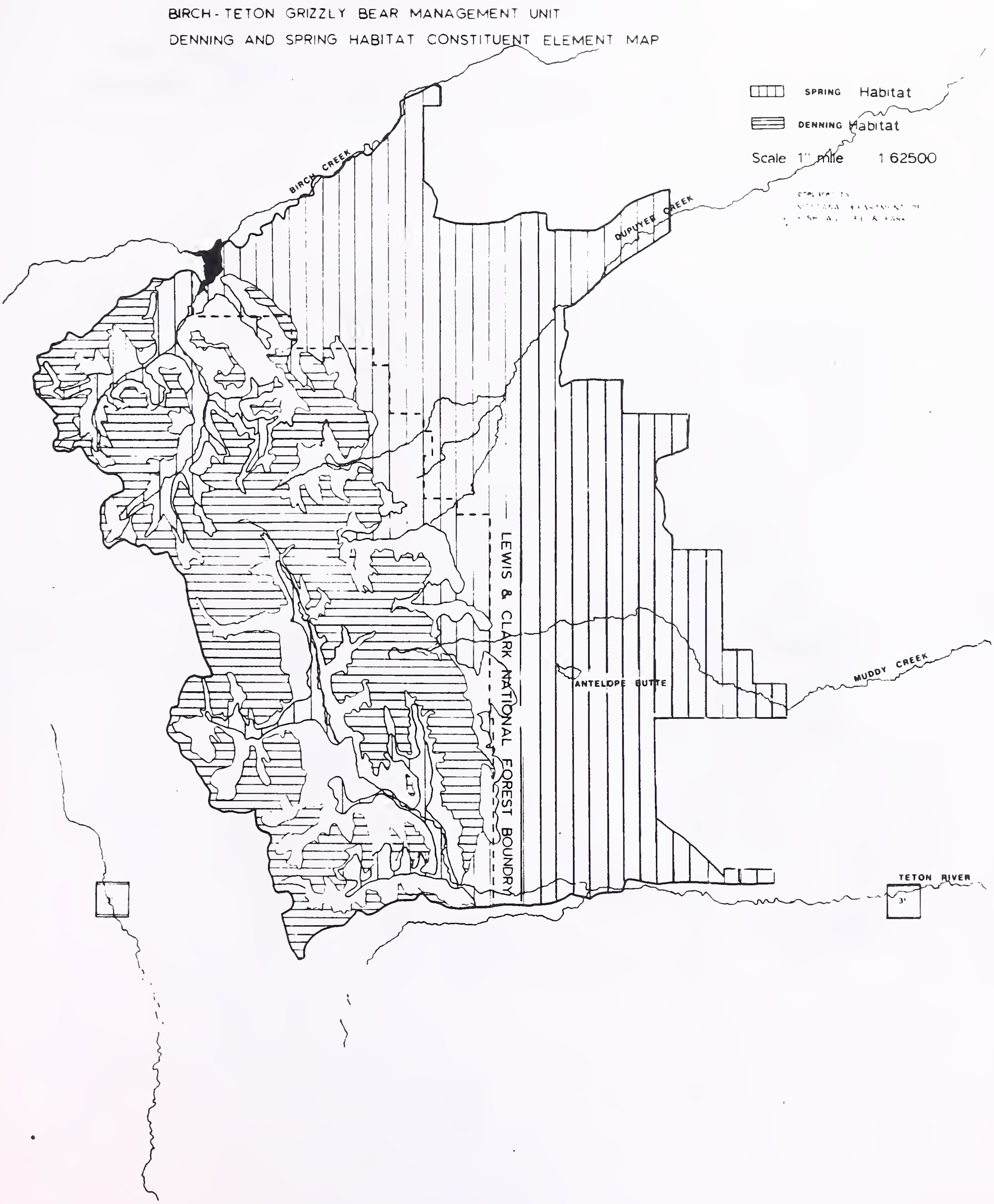

BIRCH-TETON GRIZZLY BEAR MANAGEMENT UNIT
DENNING AND SPRING HABITAT CONSTITUENT ELEMENT MAP
SPRING Habitat
DENNING Habitat
Scale 1'' mile 1 62500
BIRCH CREEK
DUPUYER CREEK
LEWIS & CLARK NATIONAL FOREST BOUNDRY
ANTELOPE BUTTE
MUDDY CREEK
TETON RIVER
3"

Figure 51. Constituent element map, 1986.

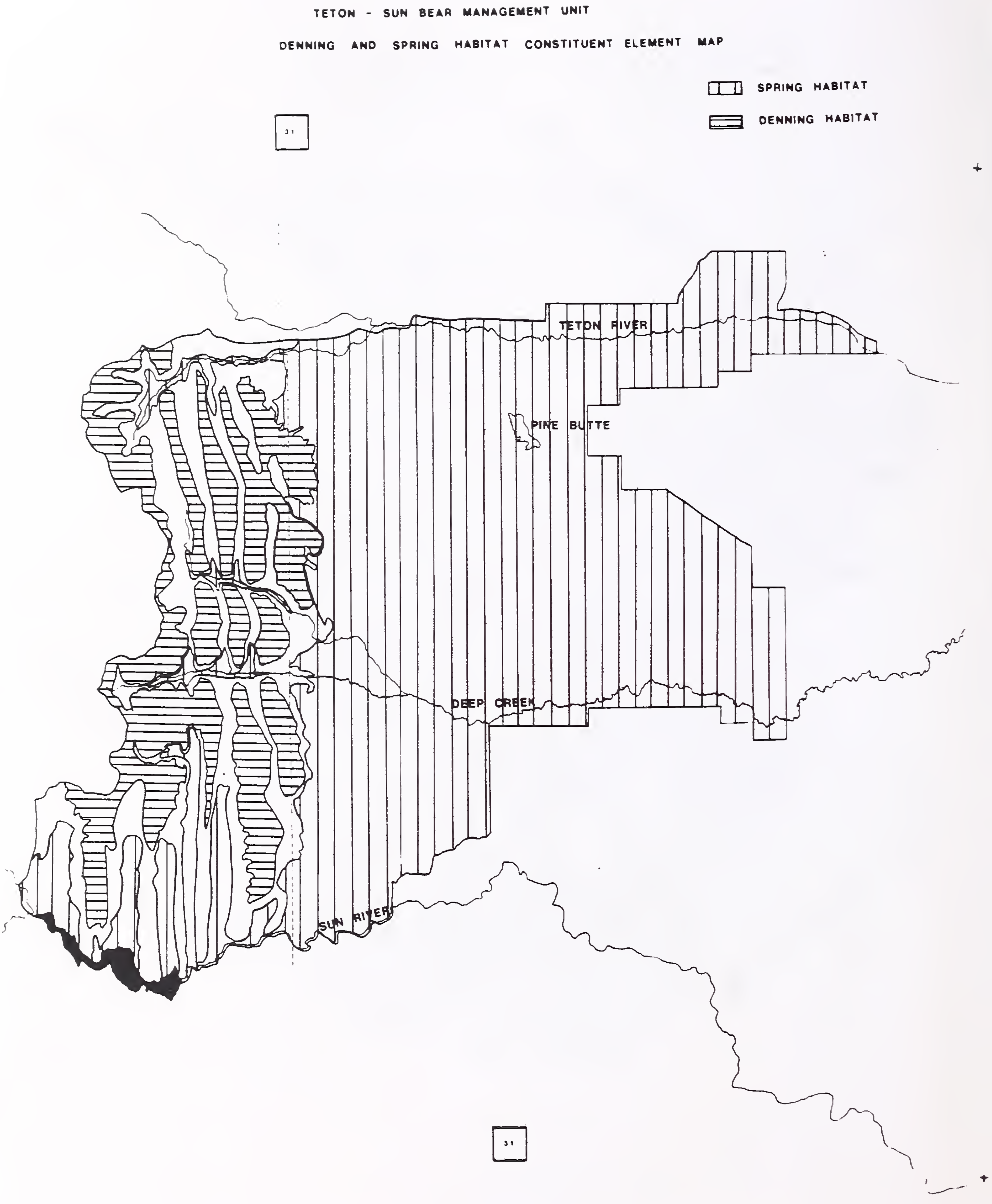

TETON - SUN BEAR MANAGEMENT UNIT
DENNING AND SPRING HABITAT CONSTITUENT ELEMENT MAP
SPRING HABITAT
DENNING HABITAT
31
TETON RIVER
PINE BUTTE
DEEP CREEK
SUN RIVER
31

Figure 52. Constituent element map, 1986.

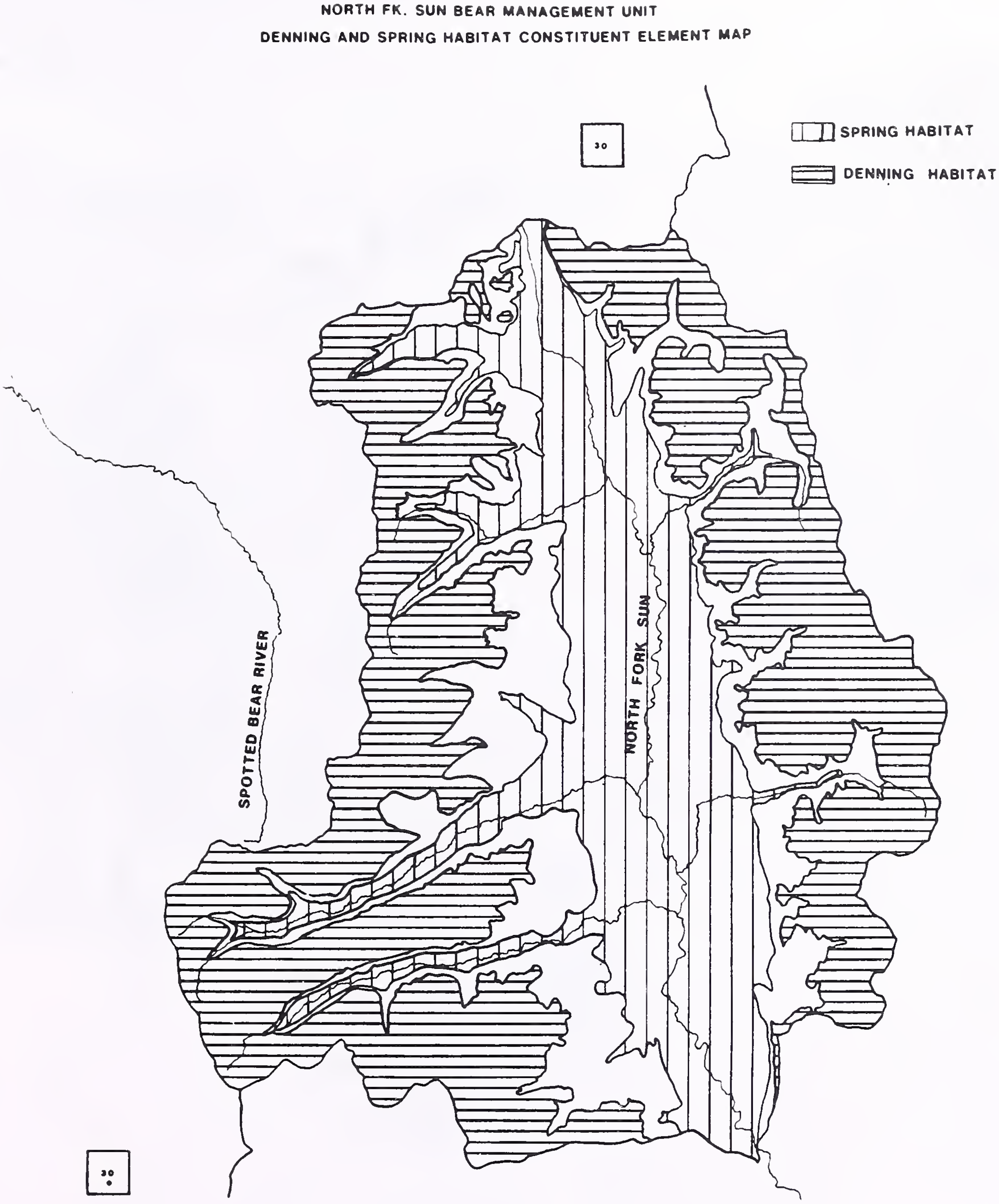

NORTH FK. SUN BEAR MANAGEMENT UNIT
DENNING AND SPRING HABITAT CONSTITUENT ELEMENT MAP
SPRING HABITAT
DENNING HABITAT
30
SPOTTED BEAR RIVER
NORTH FORK SUN
30

Figure 53. Constituent element map, 1986.

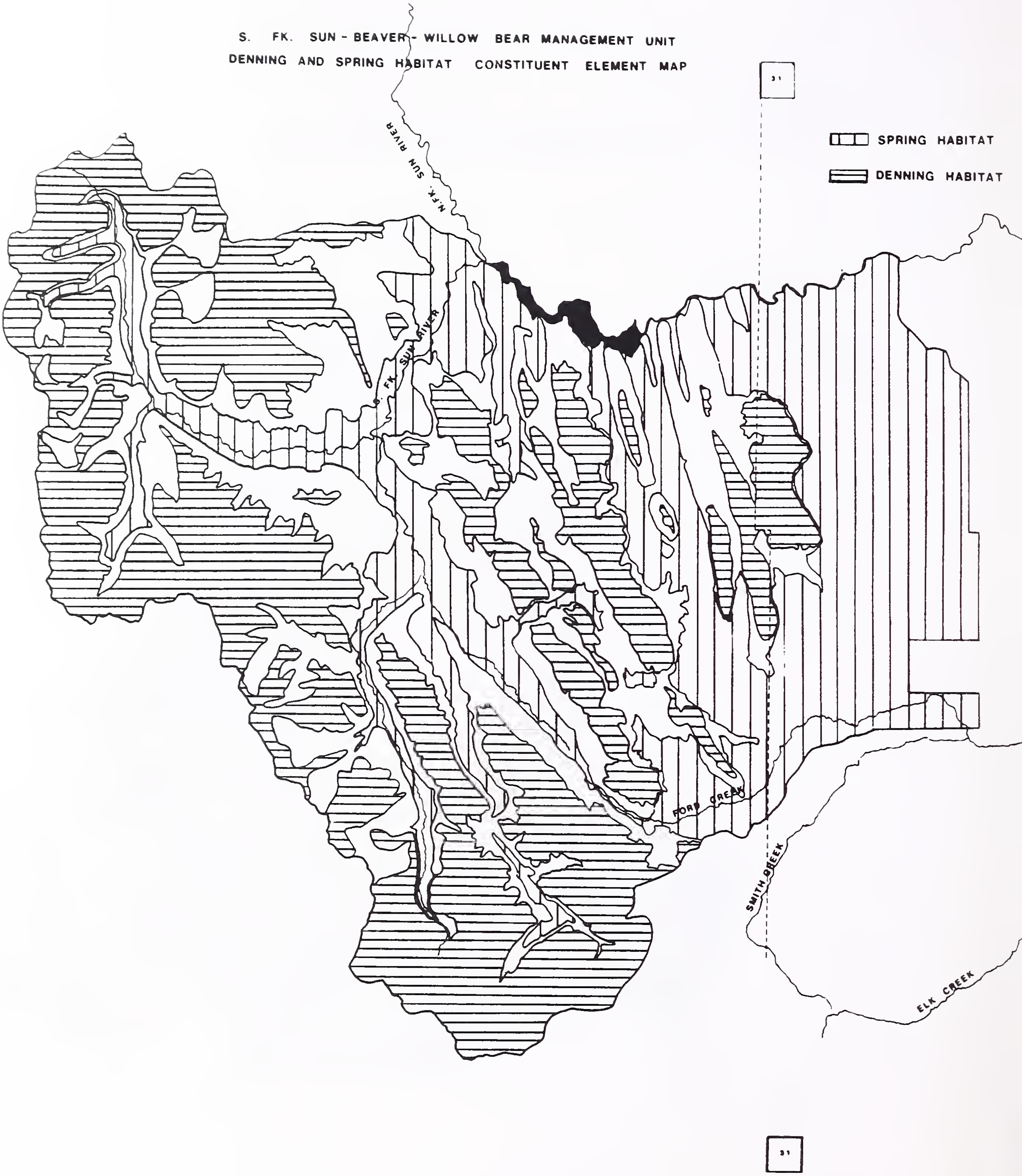

S. FK. SUN - BEAVER - WILLOW BEAR MANAGEMENT UNIT
DENNING AND SPRING HABITAT CONSTITUENT ELEMENT MAP
SPRING HABITAT
DENNING HABITAT
N. FK. SUN RIVER
S. FK. SUN RIVER
FORD CREEK
SMITH CREEK
ELK CREEK
31
31

Figure 54. Constituent element map, 1986.

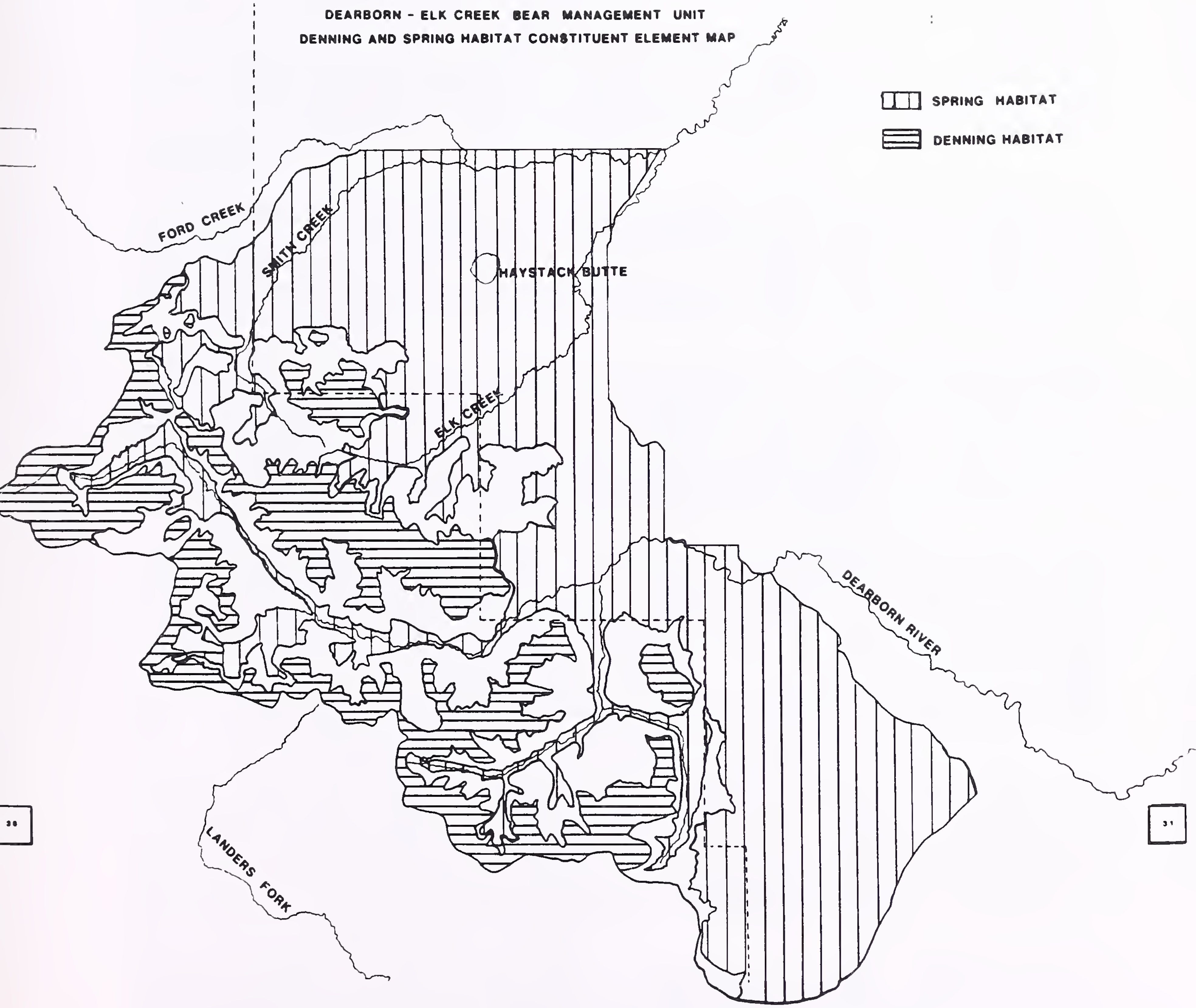


Figure 55. Constituent element map, 1986.

Table 39. Areas of bear management units and spring and denning habitat for each unit.

Bear management unit	Total area (km^2)	Denning habitat (km^2)			Spring habitat (km^2)		
		Lewis & Clark Forest	Non forest	Total	Lewis & Clark Forest	Non forest	Total
Badger-Two Med.	885.8	159.0 (99.8)[1]	0.3 (0.2)[1]	159.3 (18.0)[2]	181.8 (36.1)[3]	321.8 (63.9)[3]	503.6(56.9)[2]
Teton-Birch Cr.	870.2	210.2 (99.4)	1.3 (0.6)	211.5 (24.3)	94.5 (18.5)	417.6 (81.5)	512.1(58.8)
N. Fk. Sun River	650.1	308.0 (100.0)	0.0 (0.0)	308.0 (47.4)	204.5 (100.0)	0.0 (0.0)	204.5(31.5)
Teton-Sun River	792.5	116.9 (92.2)	9.9 (7.8)	126.8 (16.0)	52.5 (20.0)	209.7 (79.9)	262.2(33.1)
S. Fk. Sun River	808.1	415.7 (96.8)	13.9 (3.2)	429.6 (53.2)	224.4 (56.6)	171.9 (43.4)	396.3(49.0)
Dearborn-Elk Cr.	743.3	131.5 (95.9)	5.6 (4.1)	137.1 (18.4)	91.6 (21.5)	333.9 (78.5)	425.5(57.2)
Total	4750.0	1341.3 (9.4)	31.0 (0.6)	1372.3 (28.9)	849.3 (36.9)	1454.9 (63.1)	2304.2(48.5)

[1] Percent of total denning habitat within BMU
[2] Percent of total BMU area
[3] Percent of total spring range within BMU

importance to the selection of habitat by grizzly bears. Aspect, slope and elevation were the principle variables examined.

Bears used nine aspect categories to some extent in all seasons (Figure 56). The most highly used category was landscapes with less than 5% slope. These were generally flat terrain with poor drainage where aspect probably does not play a major role in the vegetative development. In our study area many of the flat areas were along the front forming the fens and adjacent riparian communities in which bears frequently were found. Northerly aspects were used extensively indicating a selection for wetter and cooler environments. Some increased use of southern exposures was noted during the spring when warmer sites may be selected after den emergence.

Elevations used by grizzly bears ranged from 1226 to 2829 m. (Figure 57). Elevation of radio locations increased seasonally from a mean in spring of 1697 m. to a mean in fall of 1837 m. A multiple range test indicated a significant difference between mean elevation in spring and summer but not between summer and fall.

During the spring, 80.3% of the locations were below 2000 m. elevation. Most of the high elevation locations were post denning or late spring locations. Receding snow line and plant phenology influence the elevational distribution of bears during the spring. The elevational distribution during the summer was broad, encompassing all elevational zones. During fall there is a somewhat bimodal distribution of elevations used by grizzlies.

We observed various patterns of elevational migration in grizzlies on the Rocky Mountain Front. Two common patterns included lowland bears that migrated from denning habitat to low elevations and remained until a pre-denning/denning period and a backcountry pattern which included a spring season migration to lowlands then a return to higher elevations during the summer and fall (Figure 58). Occasionally the backcountry bears would return to lower elevations during the berry season in late summer and fall.

Slopes used by bears ranged from flat to 100% (Figure 59) and averaged 25.3%. The percent slope of sites used by grizzly bears averaged 21.6, 25.3, and 29.8 during spring, summer and fall. A multiple range test indicated a significant difference across all seasons ($P<0.05$). The increase in slope across the seasons is consistent with the observed elevational distribution of bears.

Grizzly bears were located from 0.0 to 6480 m. from some perennial water source. They averaged 322 m. from water. There was no difference between seasons in the average distance to perennial water.

General physical characteristics such as elevation, slope, aspect and land type are important variables in determining the vegetation

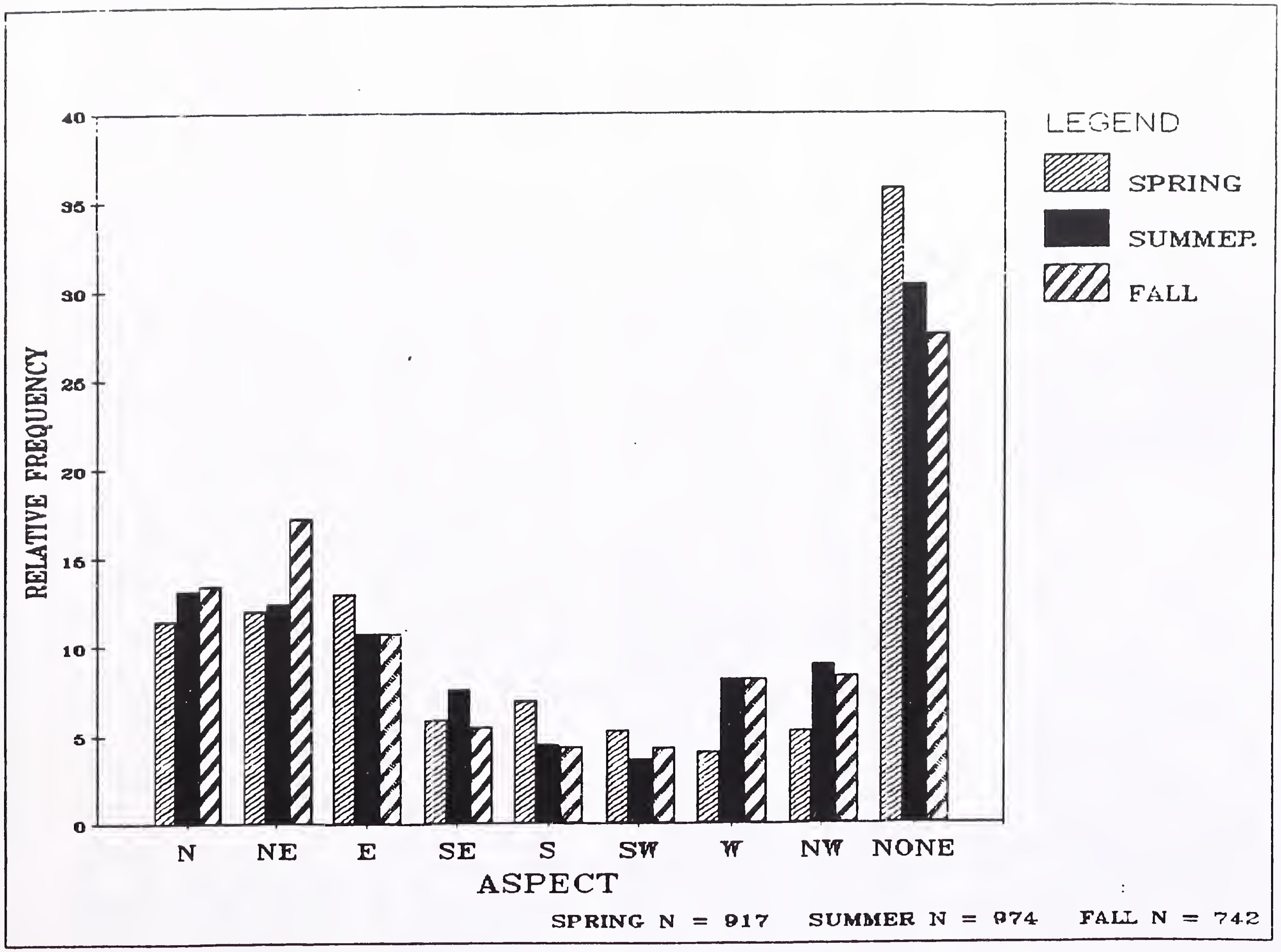


Figure 56. Grizzly bear use by aspect.

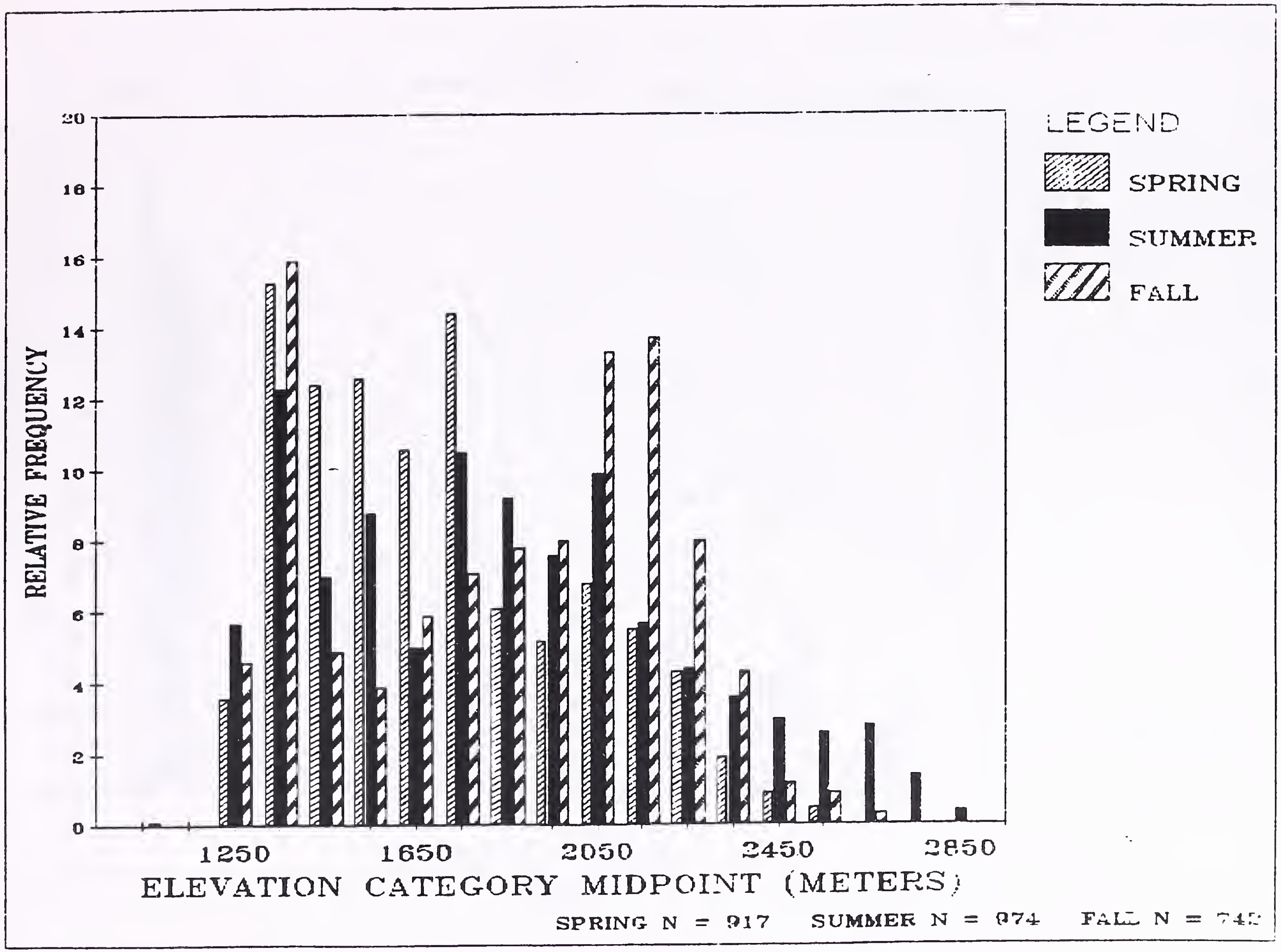


Figure 57. Grizzly bear use by elevation.

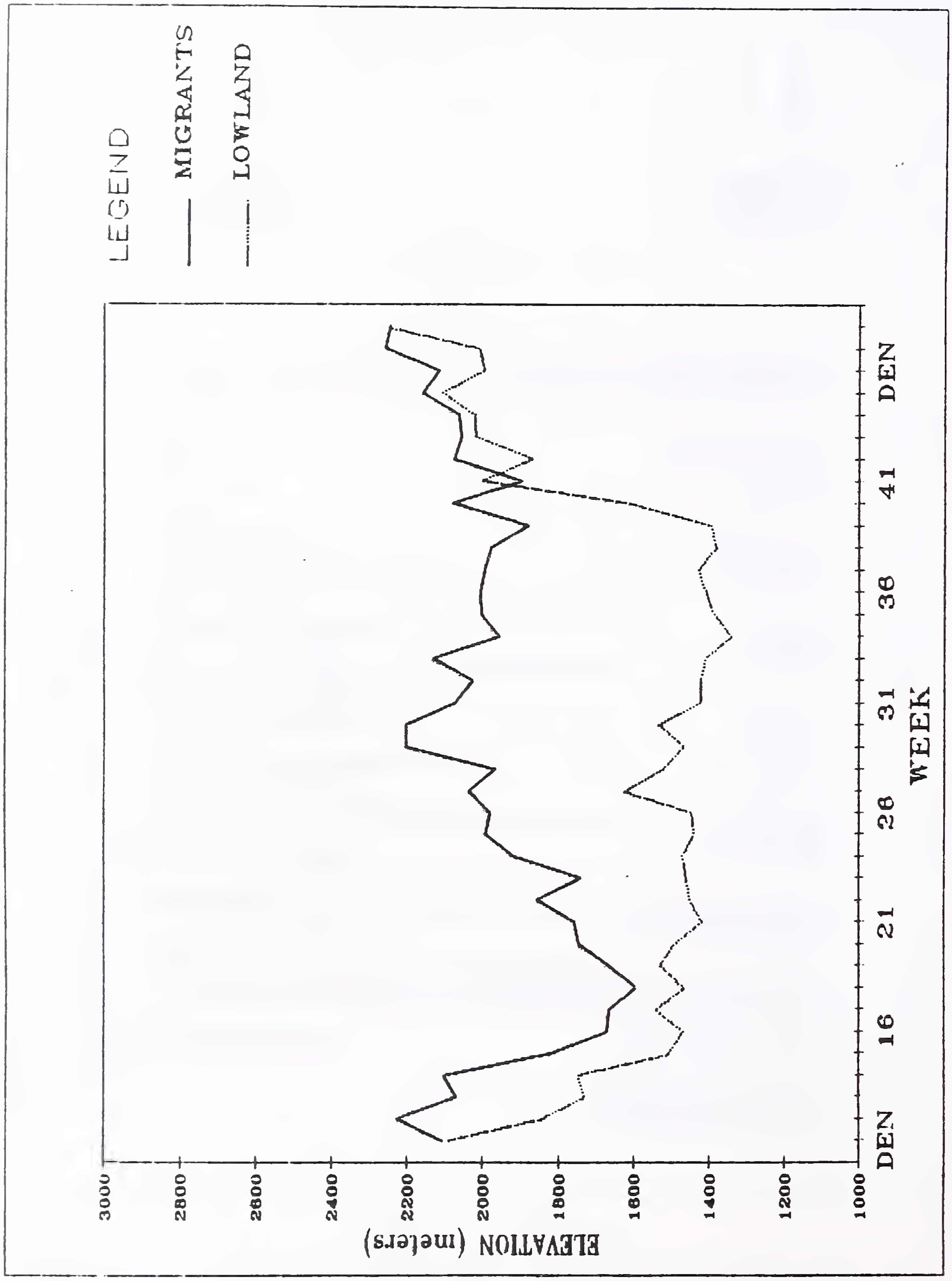


Figure 58. Elevation use patterns of grizzly bears.

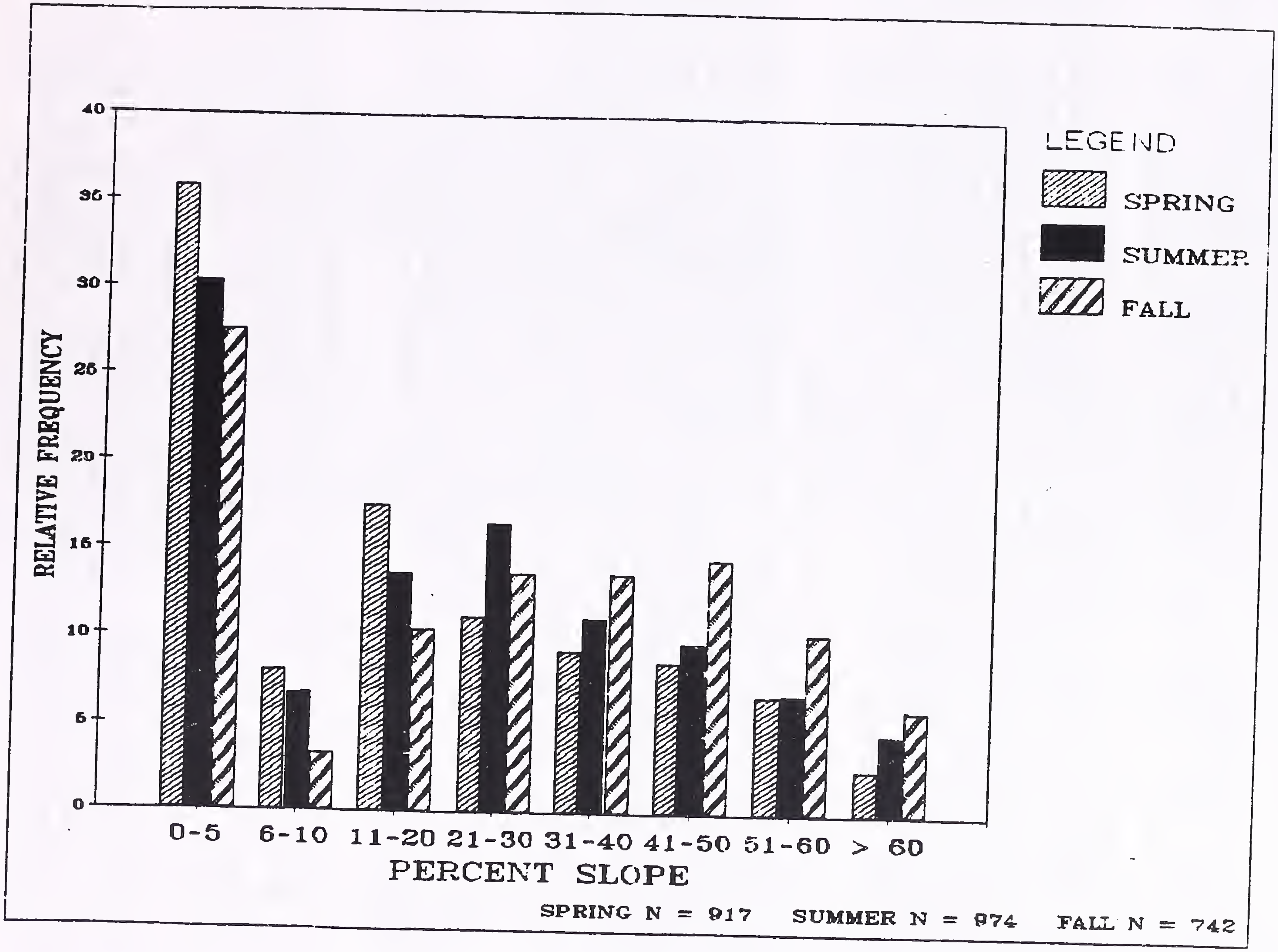


Figure 59. Grizzly bear use by slope.

which exists at each site. The relationships are complex between all variables and difficult to model. In our area, extreme weather patterns modify the effects of physical parameters as well.

While it is important to note physical parameters, a better predictor of habitat importance are classifications which take physical and vegetative parameters into account. Such a classification system did not exist for our study area.

The habitat type classifications applied to forest ecology studies were determined to be inadequate. The classification of vegetation based on climax potential does not adequately detail the current condition of the vegetation class and requires examination of each site used by bears to properly classify it. The best system which attempts to broadly classify physical and vegetal parameters with specific application to bears is the grizzly bear habitat component classification (Mealey et al 1977). We incorporated such a physical-vegetation classification scheme into our study of grizzly bear habitat use.

Habitat Components Used By Grizzly Bears

Aune and Stivers (1983) originally defined 16 habitat components important to grizzly bears. Aune et al (1984) more precisely defined the component definitions, and described grizzly bear use of each for seventeen components adding an open timber component to the list but dropping the burn, road and ridgetop components. These latter components were treated not as vegetative-physical communities but as independent physical parameters. This report will use the same definitions described in 1984 with the addition of a timbered/shrubfield to better coordinate with component classifications used in other areas of Montana.

A total of 2633 radio locations recorded from 1977-1987 were used to determine habitat component use by grizzly bears on the Rocky Mountain Front. Each radio location was assigned a habitat component code categorizing the data into 18 classes (17 habitat components and an unknown category).

We examined habitat component use within the total study area for the entire year and found use confined to 16 habitat components. One component, the cutting unit, received one radio location record. Cutting units are extremely rare in our study area because the timber program is small. The data point from cutting units was combined with the unknown category. Analysis was confined to the 16 components receiving significant use by bears.

Components were divided into two groups; the major components which include closed timber, open timber, limber pine savanna, rock/talus/scree/rubble, prairie grassland, and mountain grassland and the minor components which include meadows, timber/shrubfields, shrubfields, snowchutes, sidehill parks, populus stands, riparian shrub, and riparian complex. The major components are extensive habitats along the east front and are much more available. Minor components are less available but probably the more preferred habitats (Aune et al 1986). Habitat component availability was not determined for the entire 1800 sq. mi. study area but inference was made from the previous analysis done for the Sun River-Birch Creek area in 1986. Mapped data bases do not yet exist for the entire study area.

Site examinations were made in 319 sites or approximately 12.1% of all radio relocations (Table 40). The sample of vegetation plots includes sites used by 21 individual grizzly bears. Two components were sampled at a rate less than the 10% sample goal. Closed timber sites were often difficult to locate on the ground and in many sample efforts no discernable evidence of bear use was located. If no evidence of bear activity was located, vegetation sampling was not done. We intentionally under sampled the prairie grassland component because most of the activity was not strongly related to vegetation composition. The snowchute component was unintentionally under sampled.

Table 40. Frequency of use and the frequency of site examination by habitat component, 1977-87.

Habitat component	Observed use	Site examinations	Percent
Closed timber	887	65	7.3
Populus stands	438	60	13.7
Riparian shrub	352	51	14.5
Open timber	314	51	16.2
Rock/talus/scree	178	27	15.2
Timbered shrub	102	18	17.6
Sidehill park	75	10	13.3
Prairie grassland	54	3	5.5
Limber pine savanna	49	11	22.4
Snowchutes	39	2	5.1
Shrubfield	38	8	21.1
Riparian complex	27	6	12.2
Meadows	15	5	33.3
Mountain grassland	15	2	13.3

Seasonal shifts in habitat component use were evident for grizzly bears on the east front (Figure 60). The closed timber, populus stands, riparian shrub, and open timber components received significant bear use in all seasons. These four collectively accounted for 75.7% of all recorded use. Each demonstrated a seasonal shift in the level of use but all were consistently used at a high level. Meadows, mountain grasslands, and riparian

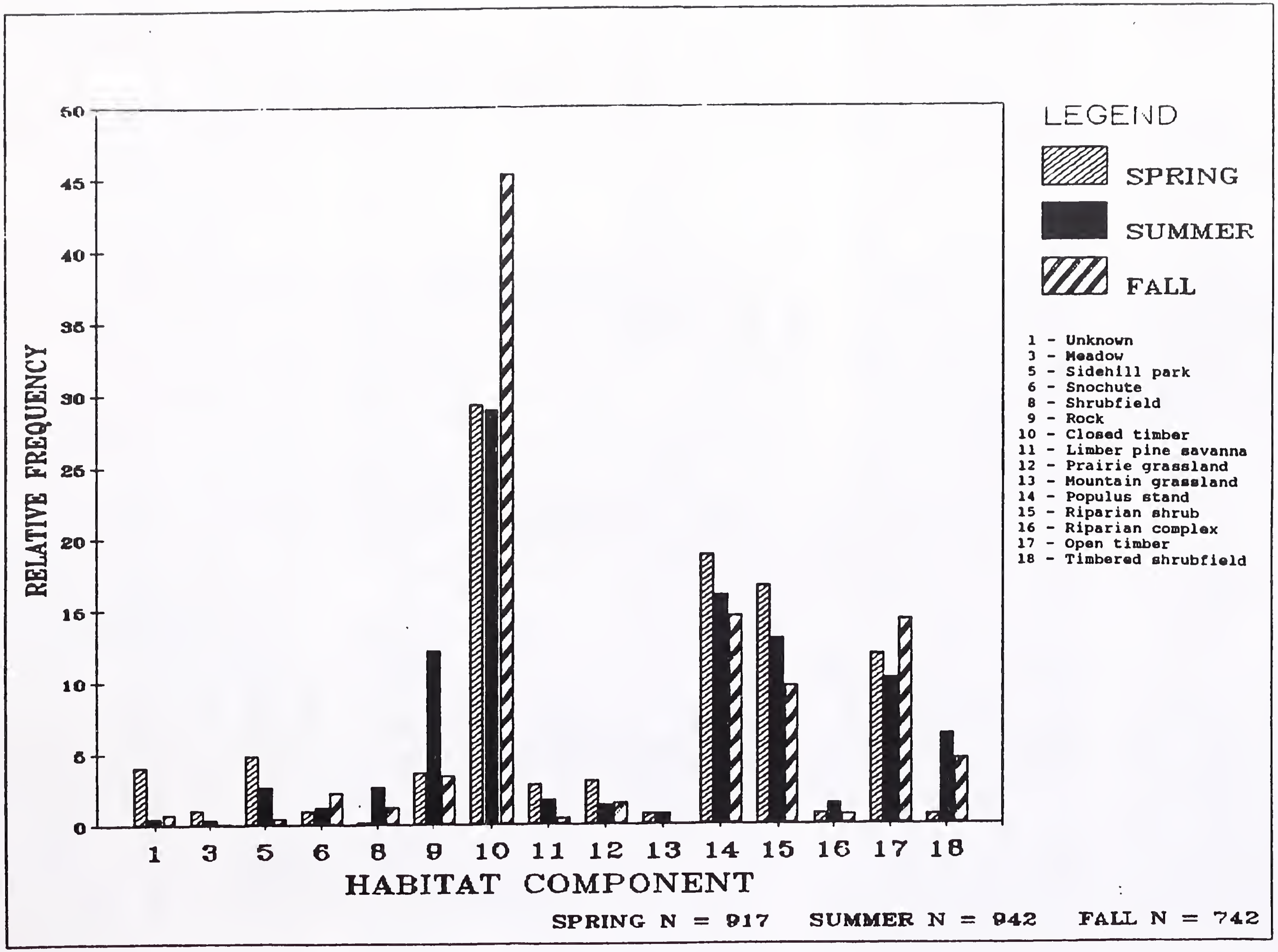


Figure 60. Grizzly bear use by habitat component.

complexes were used very little with each receiving 1.0% or less of the recorded grizzly bear use. The remaining components exhibited a seasonal use pattern.

We examined habitat component use for three geographic regions of the east front. The three regions were distinguished by geologic and vegetative differences. These regions include: the Badger-Two Medicine area, the region from the Sun River north to Birch Creek (Teton), and the area south of the Sun River.

The Badger-Two Medicine area was a cooler wetter environment with fewer limestone reefs ranging north and south. It is heavily timbered with much more mesic timber communities than those observed to the south. Bears sampled were all captured within and frequented the high country reaches of this region.

The Teton area is dominated by extensive north and south facing ridges in the mountains and drier timber communities. The mountain ranges drop off rather abruptly with riparian communities extending out onto the grassland dominated plains. Half the bears sampled were frequently using low riparian communities well out onto the plains with the other half frequenting the high country.

The area south of the Sun River was again more heavily timbered but retains the drier timber communities. Fewer limestone reefs dominate the landscape and a more pronounced rolling foothill/mountain interface occurs. A rather extensive grassland community occurs even well into the mountainous regions. Bears were more frequently found in mountainous terrain but seasonally migrated down to the riparian areas along the front.

Significant differences in the proportions of use in each component class were noted between geographic regions (Figure 61). Bears in the Teton area showed high fidelity to the riparian lowlands. Bears in the Badger-Two Medicine and Sun River South areas were predominantly using timbered communities and open mountain components.

The differences in the observed use between regions appears to be related to the availability of components and the distribution of bears sampled. The distribution of bears may be a function of where bears are allowed to live as much as an actual preference for habitat. Bears in the Teton area apparently are able to exploit more lowland country than bears to the north or south although suitable lowland habitat occurs in these other regions.

We examined seasonal use patterns for each region (Figures 62, 63, and 64) because of the different habitat use strategies between these regions. During the spring in the Teton area bears were heavily dependent on the lowland riparian and grassland communities. Grizzly bears in the Badger-Two Medicine and Sun River areas were using the open mountain communities such as

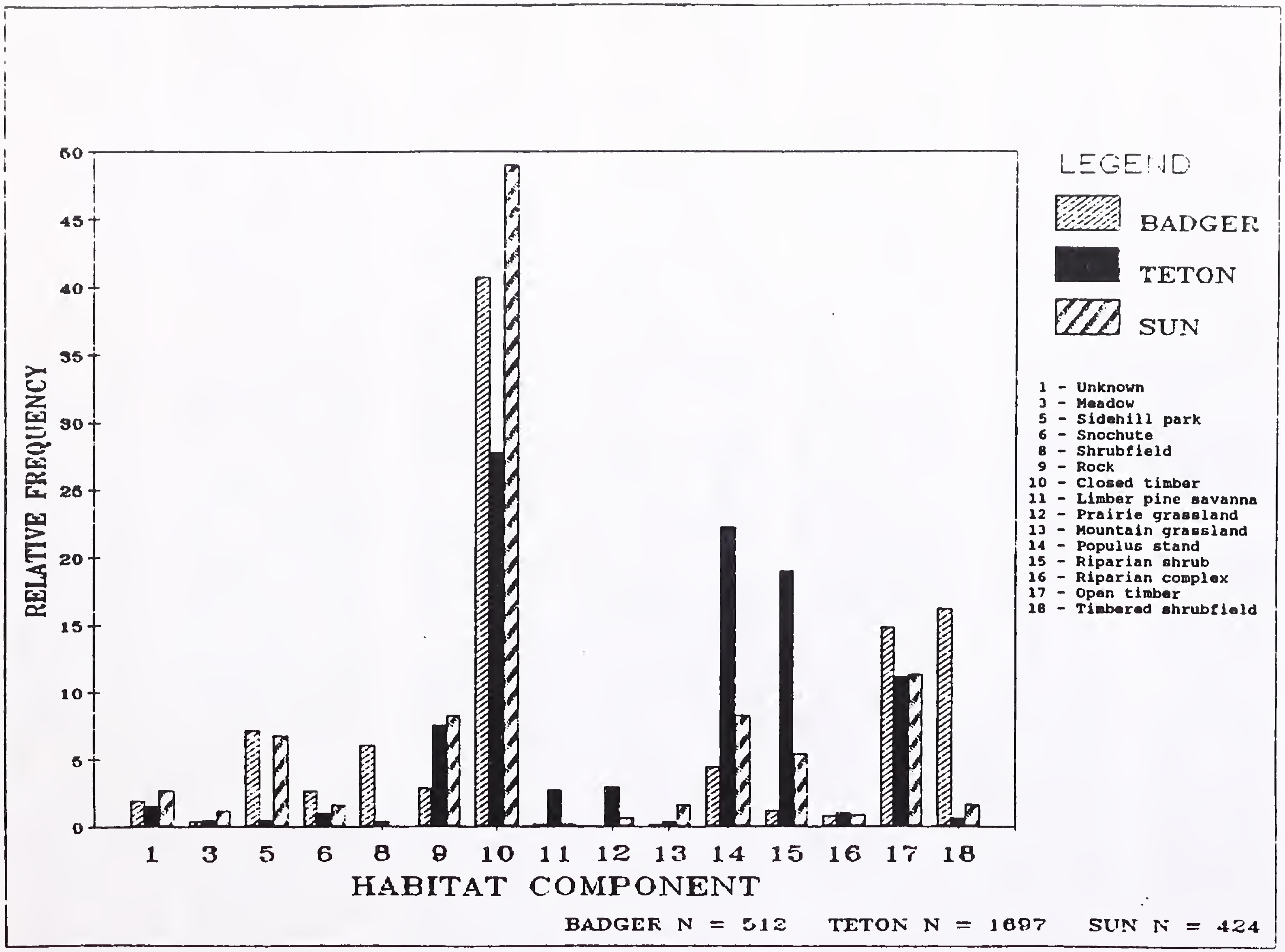


Figure 61. Grizzly bear use by habitat component, annual.

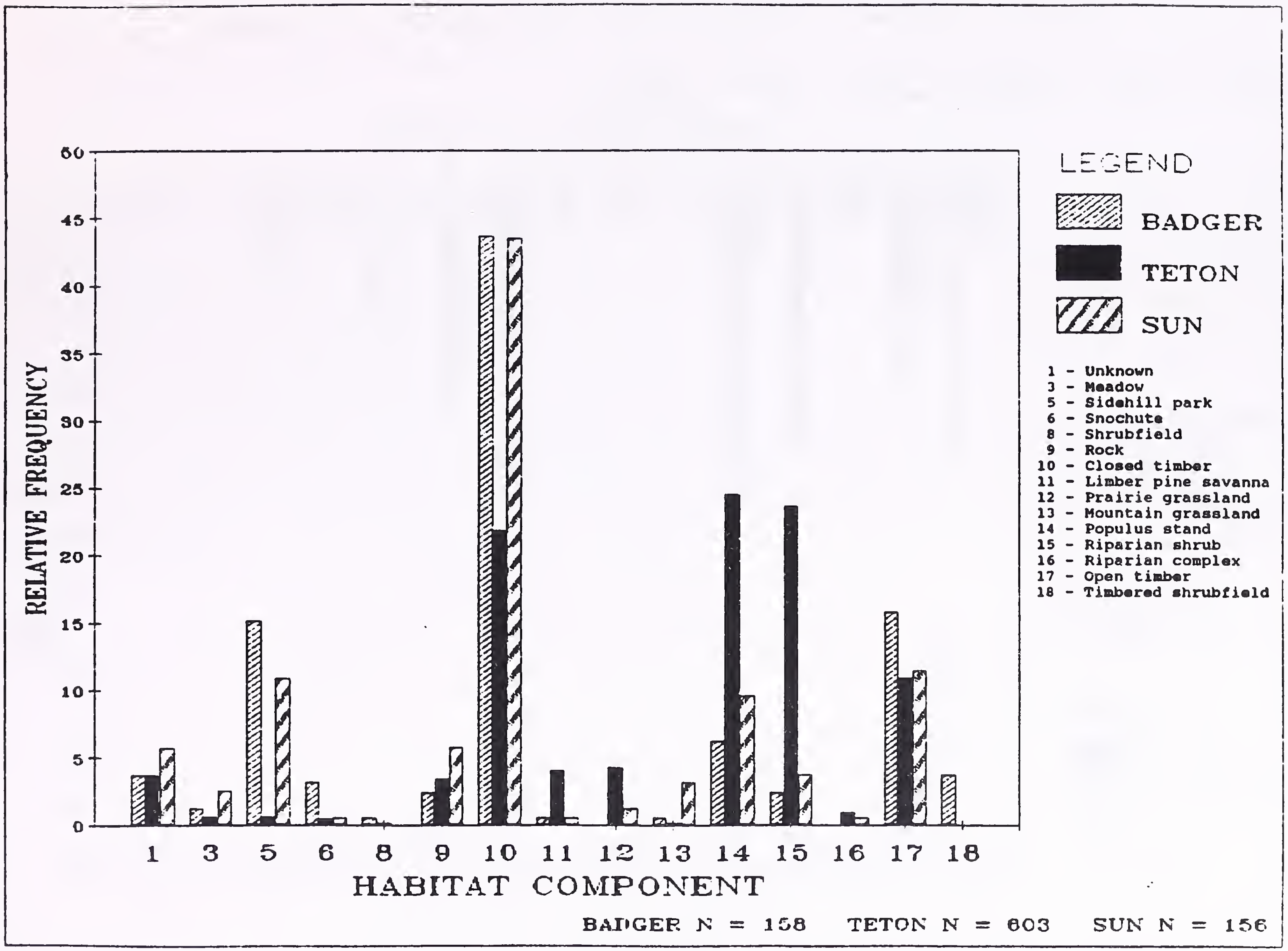


Figure 62. Grizzly bear use by habitat component, spring.

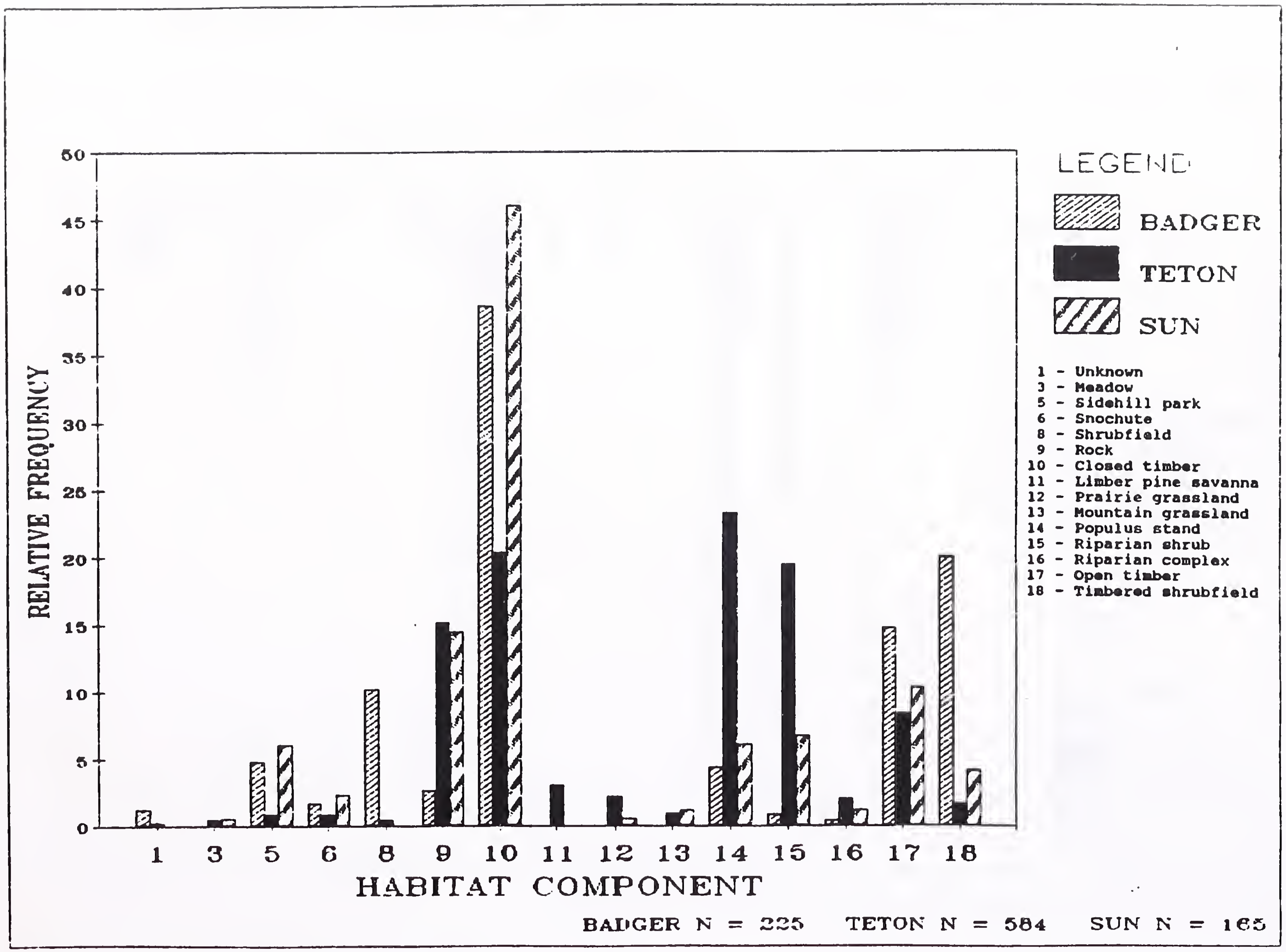


Figure 63. Grizzly bear use by habitat component, summer.

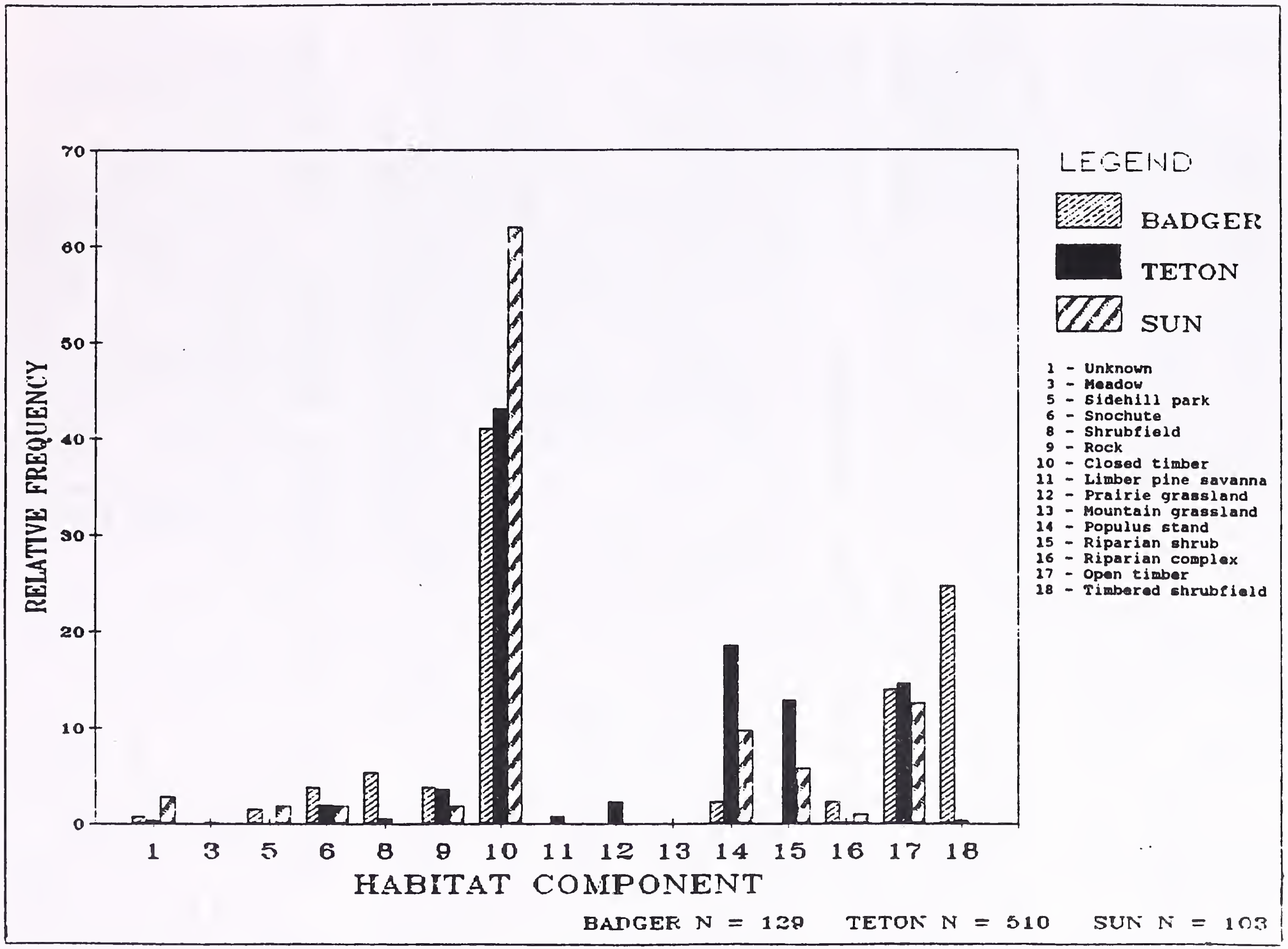


Figure 64. Grizzly bear use by habitat component, fall.

sidehill parks and avalanche chutes as well as timber communities, populus stands, and riparian shrub in spring.

During the summer bear use shifts into the rock/talus/scree/rubble communities in the Sun River and Teton areas where bears dig extensively for roots. In the Teton some bears were using the lowland berry producing populus stands and riparian shrub communities. In the Badger-Two Medicine a significant shift occurred into mountainous berry producing areas such as shrubfield and timber shrubfield areas. Use of open forage producing habitats decreased in all three areas.

By fall, most of the bear use is confined to timber communities. In the Teton and Sun River area, bears are searching for pine nuts in the whitebark pine forests. This is particularly pronounced in the Sun River area. In the Teton area, some bears are using the berry producing populus and riparian shrub communities. The Badger-Two Medicine bears used shrub producing timber communities.

Specific Analysis of Habitat Components

Each of the 16 habitat components used by grizzly bears on the Rocky Mountain Front was examined for: the season of use, observed activities of grizzly bears, physical characteristics such as slope, aspect and elevation, and vegetative characteristics. In the following section, data will be presented for each component to precisely describe and quantify its character and use by grizzly bears in our study area.

Closed Timber

Closed timber components are plant communities dominated by coniferous trees with a canopy coverage of at least 40%. Average canopy coverage of coniferous trees in closed timber sites used by grizzly bears was 63.8% (Table 41). Most of the coniferous canopy was composed of trees with a diameter at breast height (dbh) less than 10 cm. A detailed summary of vegetation composition for the closed timber component is presented in Appendix F.

The under story in this component was highly variable depending upon the moisture conditions, elevation, slope, and soils. In general a fairly well developed layer of medium and low shrubs with a forb and grass ground layer best describes this component. The closed timber sites used by grizzlies along the Rocky Mountain Front were relatively dry as indicated by species composition. Approximately one third of the forb canopy was beargrass. Important bear foods such as Heracleum lanatum, Osmorhiza, Erythronium, and Angelica were frequently found in the closed timber component, however, were often not abundant at these sites. Occasional spruce forests along riparian corridors did provide abundant forb or grass feeding sites for grizzlies.

Table 41. Summary of data from vegetation plots (N=65) taken at radio locations of grizzly bears within the closed timber habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	7	44.2	96.9
> 10 cm. dbh	8	19.6	95.4
Shrubs			
Tall	6	2.1	29.2
Medium	26	14.0	89.2
Low shrubs/vines	11	14.9	81.5
Ferns and allies	3	0.5	10.8
Graminoids	17	8.2	75.4
Forbs	68	35.9	98.5
Moss	-	2.0	32.3
Soil	-	10.0	87.7
Rock	-	2.7	58.5

Bear use of the closed timber component was recorded in 46 different Pfister habitat types. Bears generally used the Psme and Abla series habitat types during spring (Table 42). During summer and fall, use was concentrated in the upper subalpine fir and whitebark pine habitat types.

Table 42. The frequency of habitat type series within the closed timber component used by grizzly bears on the Rocky Mountain Front, 1977-87.

Habitat type series	Frequency			
	Spring	Summer	Fall	Total
Scree	3	0	0	3
PiFl	0	2	0	2
Psme	92	73	33	198
Picea	30	36	17	83
Lower abla	94	114	137	345
Upper abla/pial	34	47	144	225
Pico	6	1	1	8
Other	10	9	5	22

Elevations of the closed timber component used by grizzly bears ranged from 1219 m. to 2536 m. Elevations of sites used by bears increased from spring to fall (Figure 65).

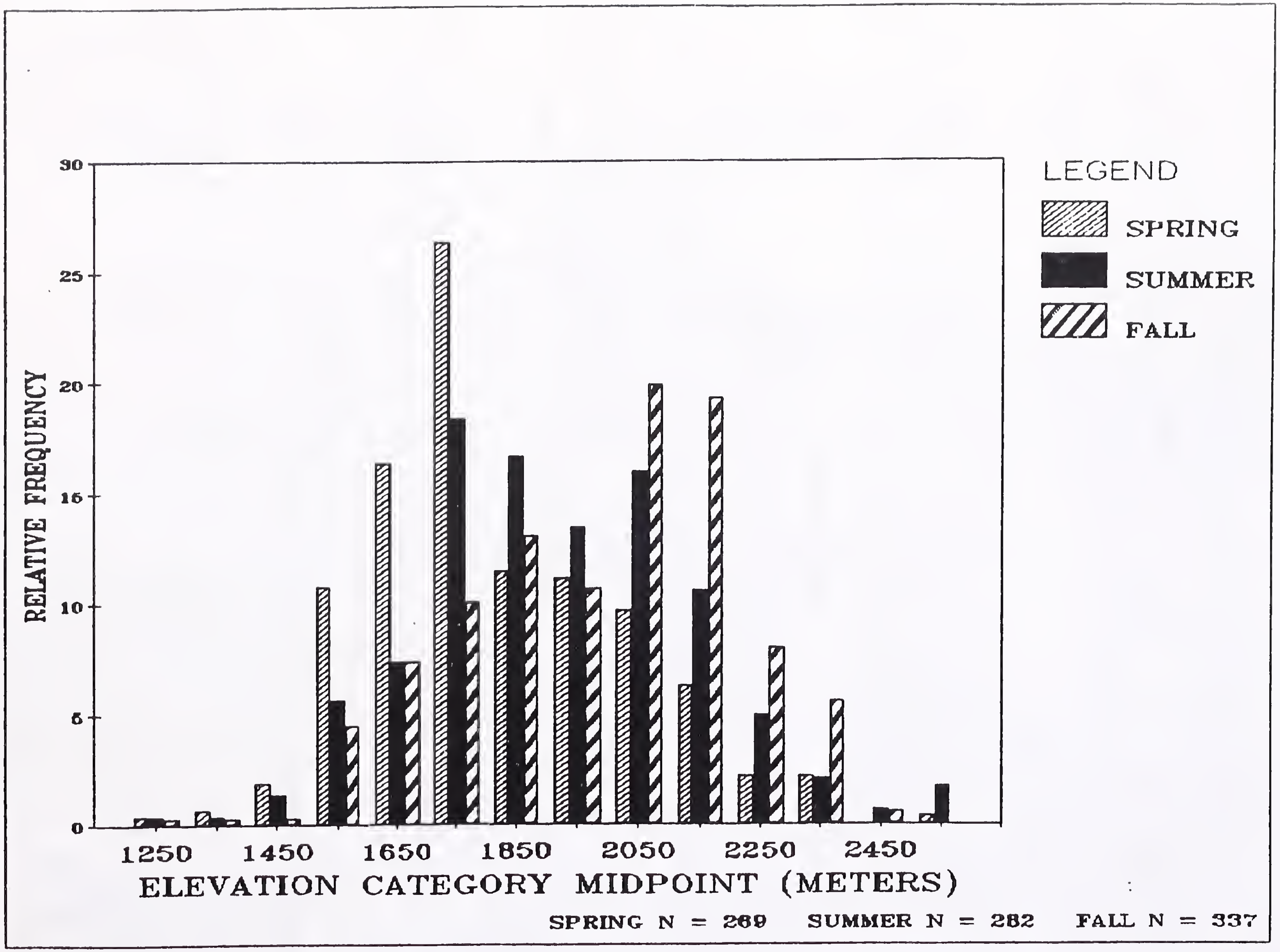


Figure 65. Grizzly bear use of closed timber by elevation.

Aspect of closed timber sites used by bears were mostly northerly (Figure 66). There was an increased use of south and southwest exposures during the spring and the fall. During the summer use shifted to the cooler northerly aspects. There are probably more closed timber mesic habitats on the northerly slopes of the east front where coniferous forests receive protection from desiccating southwest winds southwest. This higher occurrence of use in closed timber on northerly exposures is probably related to availability.

Slopes of closed timber sites most used by grizzlies ranged from 0 to 80% (Figure 67). Use centered around the mid to upper slopes. There was a general increase in the slope of closed timbered components used by grizzlies as they increased their use of higher elevations.

Activities of bears within the closed timber component were determined on an annual and seasonal basis (Table 43). Major activities observed within this component included: insect feeding, carrion feeding, pine nut digging, bedding, traveling, and denning activities. The occurrence of grazing activities was concentrated during the spring/early summer on the more mesic habitat types within this community where grass and forb under stories were dominant.

Table 43. The frequency of grizzly bear activities observed within the closed timber component annually and seasonally, 1977-87.

Activity	Spring	Summer	Fall	Annual
Carrion	8	2	7	17
Grazing	4	2	0	6
Digging roots	1	6	2	9
Digging pine nuts	0	2	27	29
Digging small mammals	0	0	1	1
Insect feeding	3	9	0	12
Feeding on berries	0	6	3	9
Striping bark	0	1	0	1
Other feeding	3	6	6	15
Bedded	48	37	14	99
Traveling	19	17	19	55
Mating/courting	11	0	0	11
Denning	25	0	50	75
Other non-feeding	5	1	1	7

The closed timber component received grizzly bear use from den emergence until den entrance (Figure 68). Use was consistently high for this component during all seasons. Fall was the one

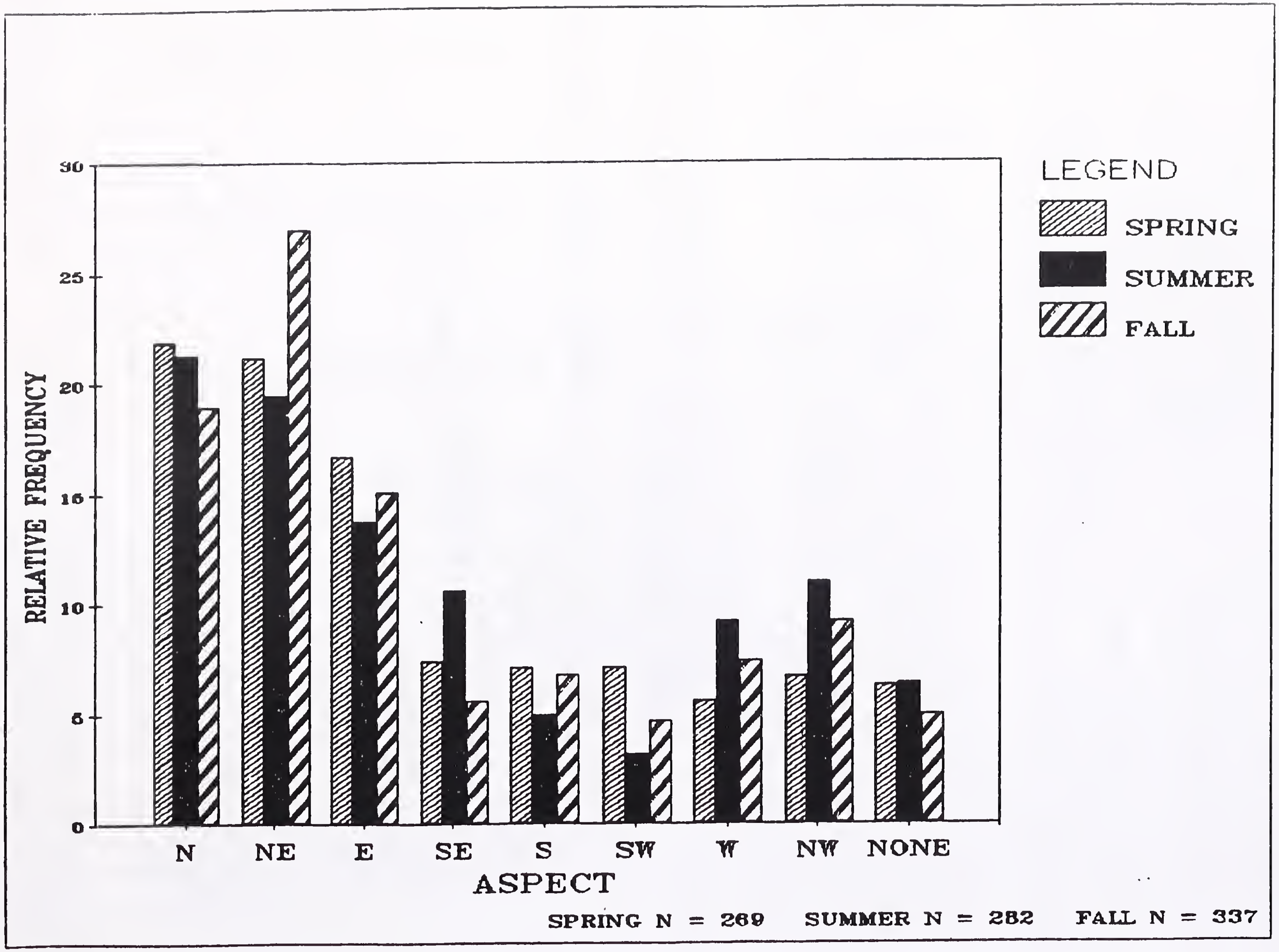


Figure 66. Grizzly bear use of closed timber by aspect.

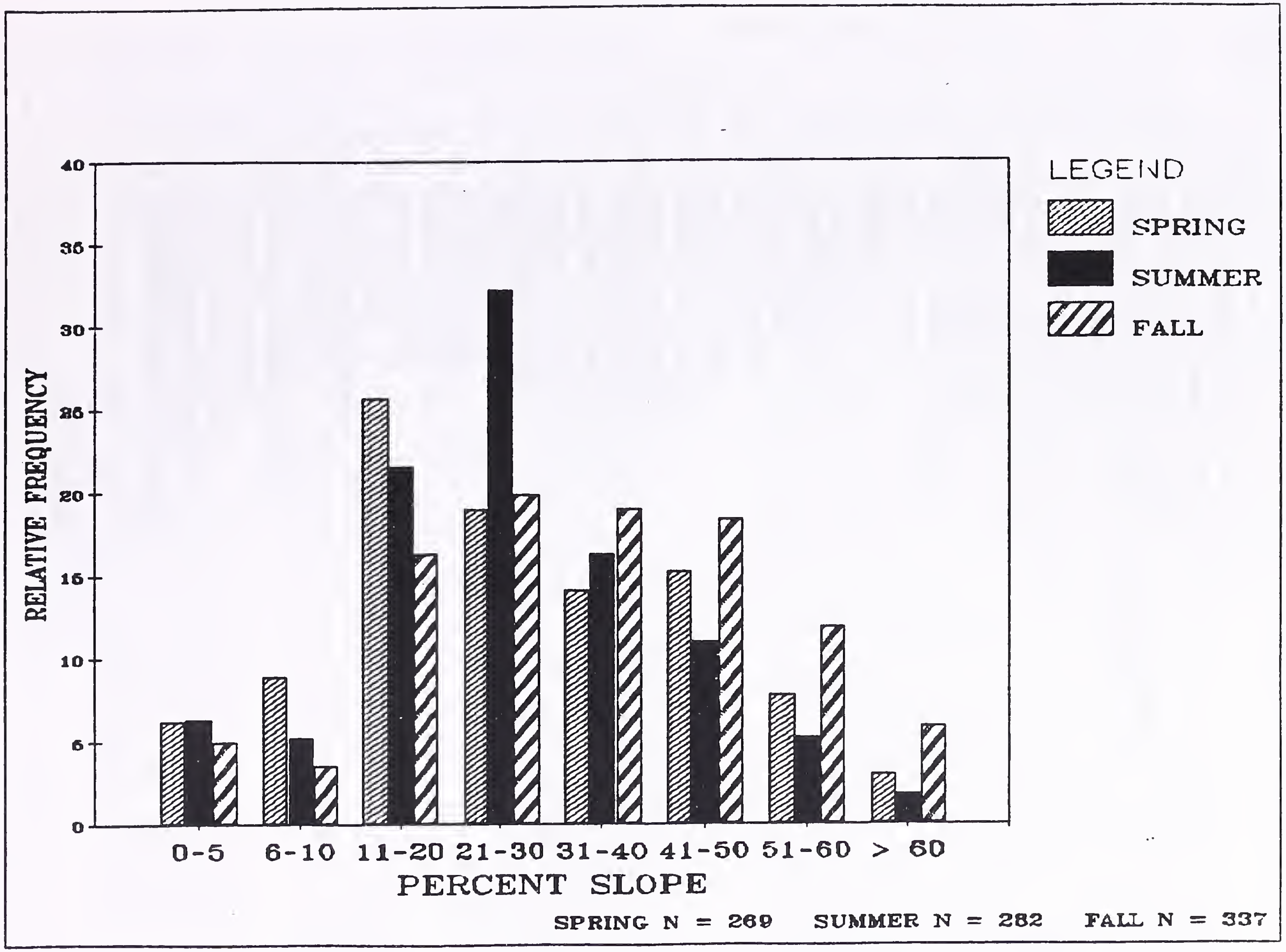


Figure 67. Grizzly bear use of closed timber by slope.

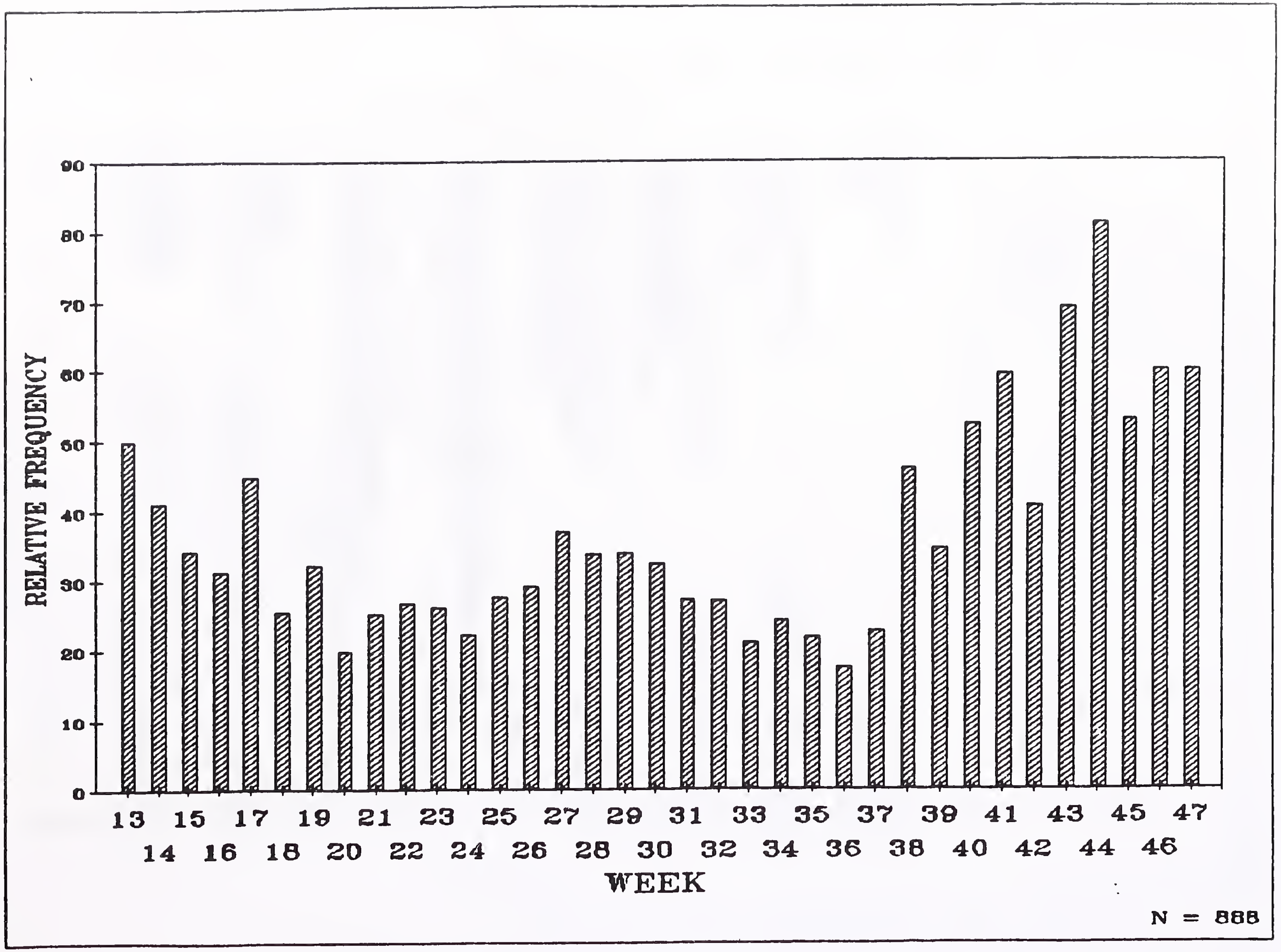


Figure 68. Grizzly bear use of closed timber by week.

season showing a significant increase in use of the closed timber habitats as bears moved toward dens and fed on whitebark pine nuts. This substantial increase during the fall correlates well with the arrival of first frosts in September and the end of the berry feeding season.

The closed timber component was often used as a refuge for bears utilizing the adjacent open feeding areas such as sidehill parks, snowchutes, and meadows. Its importance for cover as well as food production is documented in many studies (McLellan and Mace 1985, Blanchard 1983, Graham 1978, Zager 1980). The wide variation of vegetation and elevational distribution of this component make it universally important but consequently difficult to further classify. Cover value of the closed timber may be as important as food values, threfore, we did not feel confident that further classification of the closed timber base solely on plant food available would be warranted without further detailed investigations or detailed mapping efforts. Unsuccessful attempts have been made to develop terrain models which would predict habitat type based on slope, aspect, and elevation for our study area. Until predictive models are successful, or some other method is developed to discriminate between timber types, classification of bear habitat within this component will be difficult on the Rocky Mountain Front.

Open Timber

Open timbered components are sparsely to moderately timbered plant communities significantly influenced by a coniferous tree canopy. Coniferous tree canopies ranged from 10 to 40%. Associated under story may vary from a grass to forb dominated depending upon soils, slope, elevation and moisture conditions. This component commonly occurs at upper and lower ends of timber line or adjacent to some open components such as sidehill parks, snowchute, shrubfields, meadows, and grasslands. Detailed results from vegetation plots conducted in this component are presented in Appendix F.

The average coniferous tree canopy coverage for open timbered components used by grizzlies was 30.4% (Table 44). The canopy was equally split between small and large dbh trees. Species composition for the tree canopy was very similar to that for the closed timber component.

The under story canopy within this component varied widely. The under story of open timber was predominantly grasses and forbs. Important forbs used by bears were not frequent or abundant within this component. One third of the forb cover was beargrass. In general, the habitat types prevalent within this component were dry or xeric.

Table 44. Summary of data from vegetation plots (N=49) taken at radio locations of grizzly bears within the open timber habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	7	19.4	94.1
> 10 cm. dbh	7	11.4	98.0
Shrubs			
Tall	4	0.4	15.7
Medium	20	13.4	84.3
Low shrubs/vines	12	8.4	80.4
Ferns and allies	2	0.4	7.8
Graminoids	19	8.8	84.3
Forbs	109	31.8	100.0
Moss	-	1.2	17.6
Soil	-	10.8	94.1
Rock	-	4.1	70.6

Open timber components used by grizzlies included 29 different Pfister habitat types. The Psme and Abla series at the lower edge of timber line and the upper subalpine fir and whitebark pine types near the upper timberline were the most commonly used group of habitat types (Table 45).

Table 45. The frequency of habitat type series within the open timber component used by grizzly bears on the Rocky Mountain Front, 1977-87.

Habitat type series	Frequency			
	Spring	Summer	Fall	Total
Scree	2	0	0	2
PiFl	1	0	0	1
Psme	15	12	2	29
Picea	3	4	2	9
Lower Abla	32	35	26	93
Upper Abla/Pial	50	40	67	157
Pico	1	0	0	1
Other	5	8	9	22

Open timber components used by grizzly bears ranged from 1268 m. to 2768 m. in elevation. There was a notable shift in bear use to the upper elevations during the fall when bears concentrated activities in pine nut digging areas and denning habitats (Figure 69). The mean elevation of open timbered components increased from 2031 m. in the spring to 2122 in the fall. The elevational distribution of the open timber component was skewed into upper elevations whereas use of the closed timber component is more normally distributed through a broader range of elevations.

Aspects of open timbered components used by bears varied considerably with season (Figure 70). The northerly aspects were used the most during all seasons. During the spring, an increase in the occurrence of locations from southerly exposures was noted. There was a stronger representation of westerly aspects in the open timber component than the closed timber component. These west facing slopes are subject to desiccation from high winds which could account for the higher occurrence of more open timbered environments.

The open timber habitat component occurred on relatively steep slopes (Figure 71). The steeper slopes were more commonly used during the spring and fall during the post- and pre-denning periods. In the summer, the average slope of open timber components used by bears decreased. AOV analysis indicated that the slopes of open timber components were significantly ($P<0.05$) steeper than slopes of the closed timber component.

Activities of bears within the open timber component were determined on an annual and seasonal basis (Table 46). Five major activities were recorded in this component including; digging pine nuts, feeding on berries, bedding, travelling, and denning. The two major feeding activities were digging roots during the summer and pine nut digging during the fall. Bedding was a less frequent non-feeding activity in the open timber component as compared to the closed timber. This probably is related to the difference in cover value and security between these two components.

Grizzly bears used the open timber component from den emergence to den entrance (Figure 72). Open timber component use was significant during all seasons. The prominent peaks in use during the spring and fall correlate with denning activities.

Timbered Shrubfield

The timbered shrubfield component is a relatively open canopied timber site with tree cover between 10 and 60% with a distinctly shrub dominated under story. The average canopy coverage of trees was 49.9% with an average shrub canopy of 84.1% for timbered shrubfields used by bears (Table 47). As with the closed timber component, the tree canopy was predominantly the smaller dbh trees.

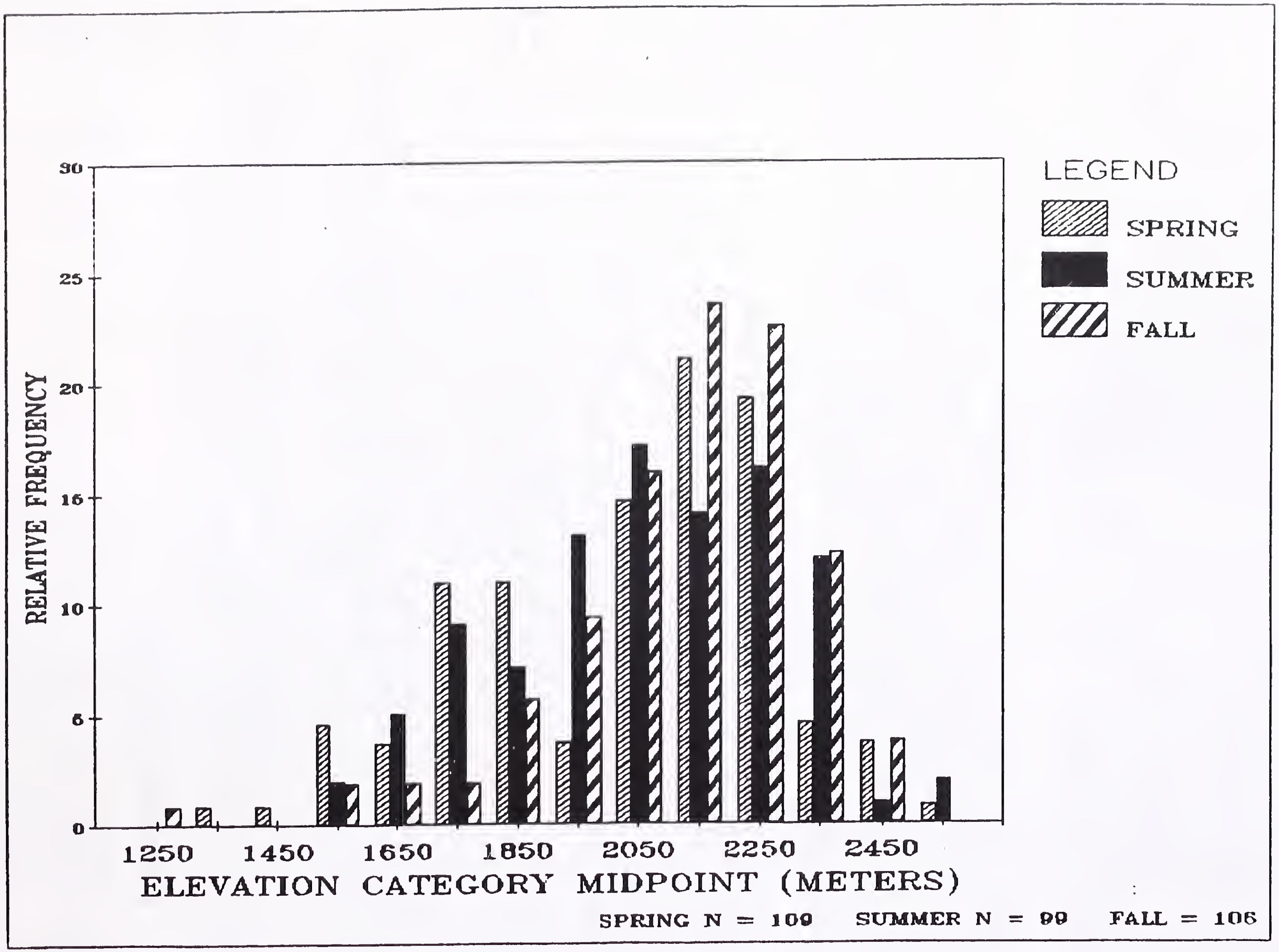


Figure 69. Grizzly bear use of open timber by elevation.

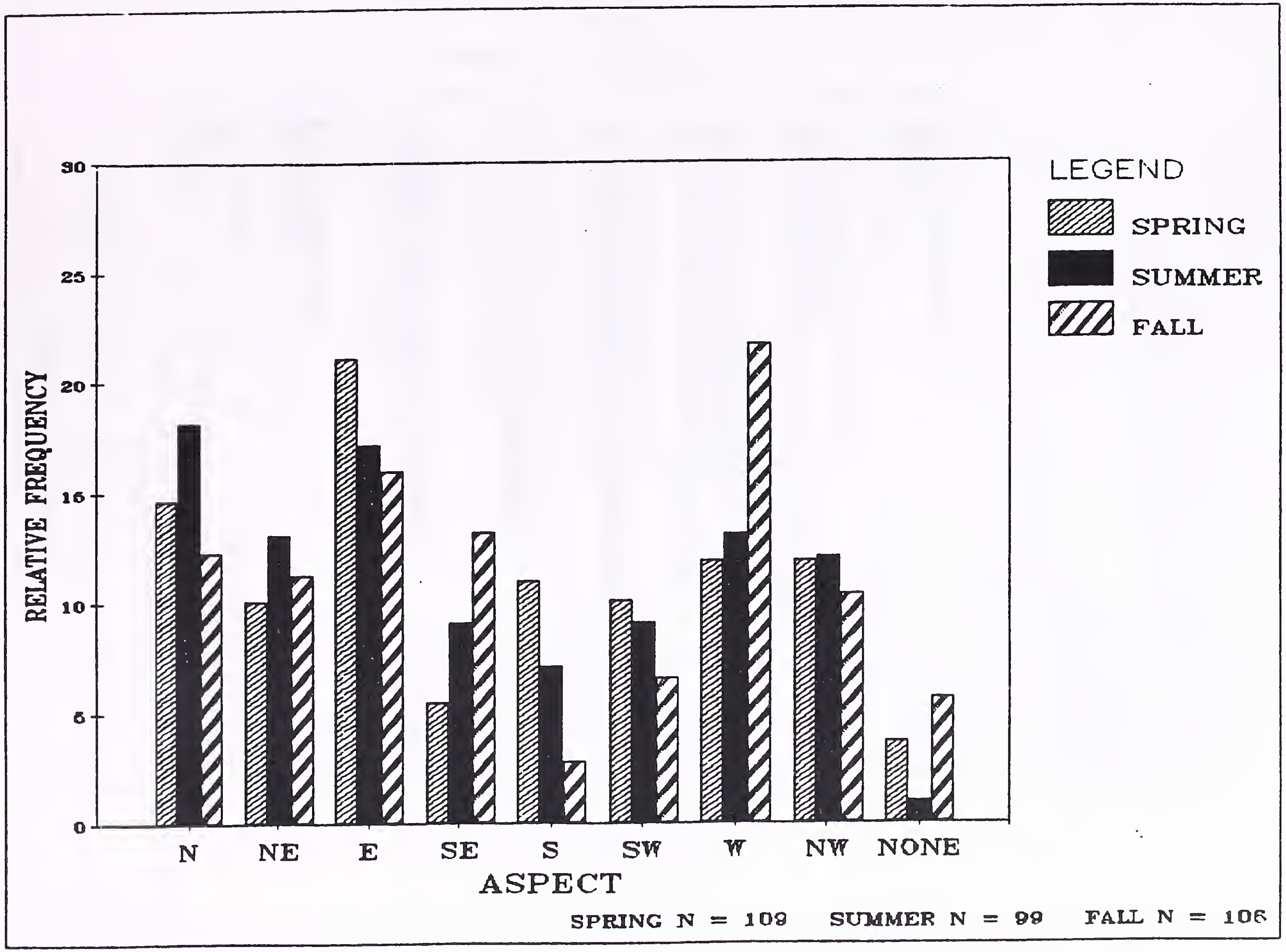


Figure 70. Grizzly bear use of open timber by aspect.

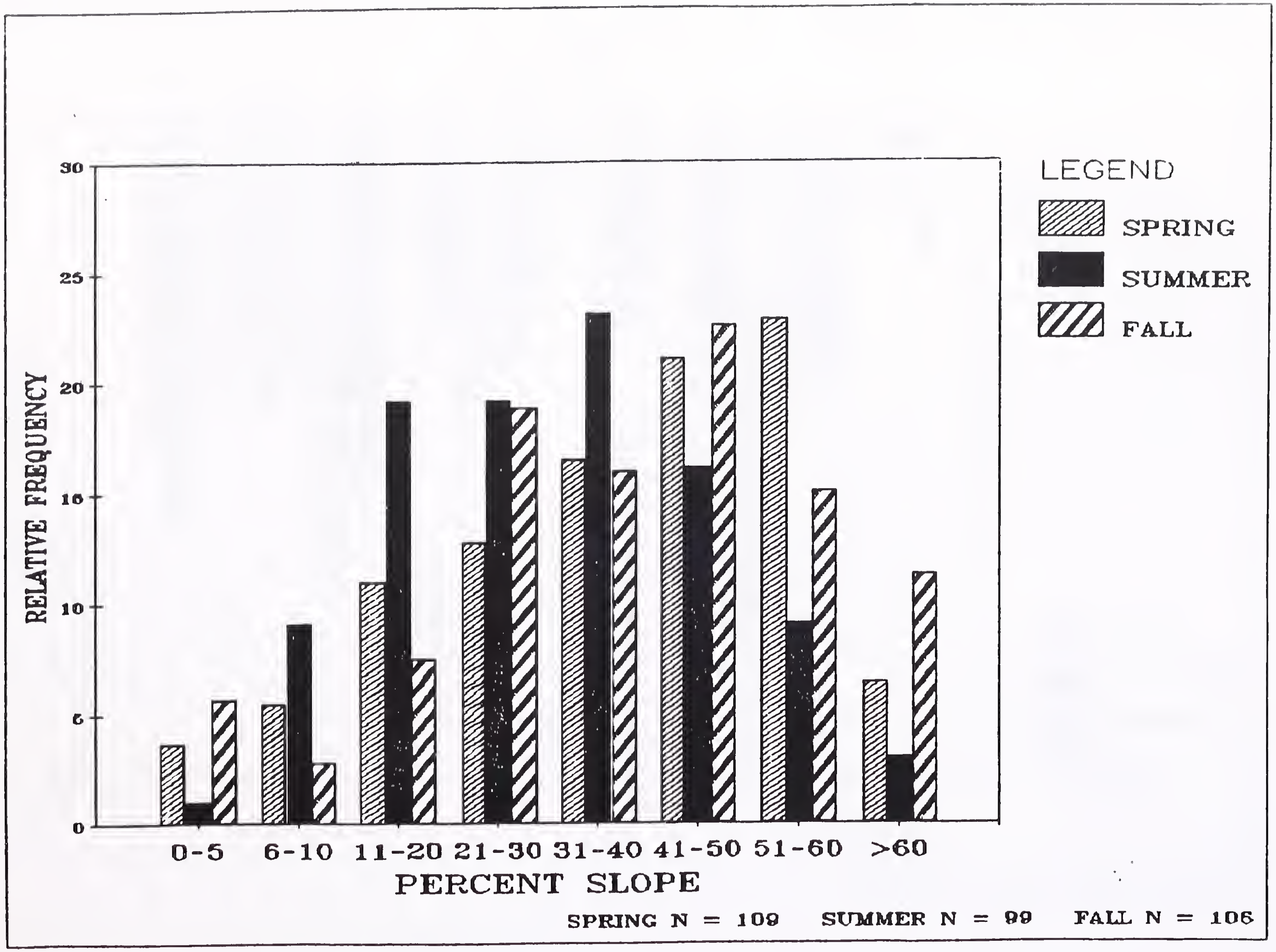


Figure 71. Grizzly bear use of open timber by slope.

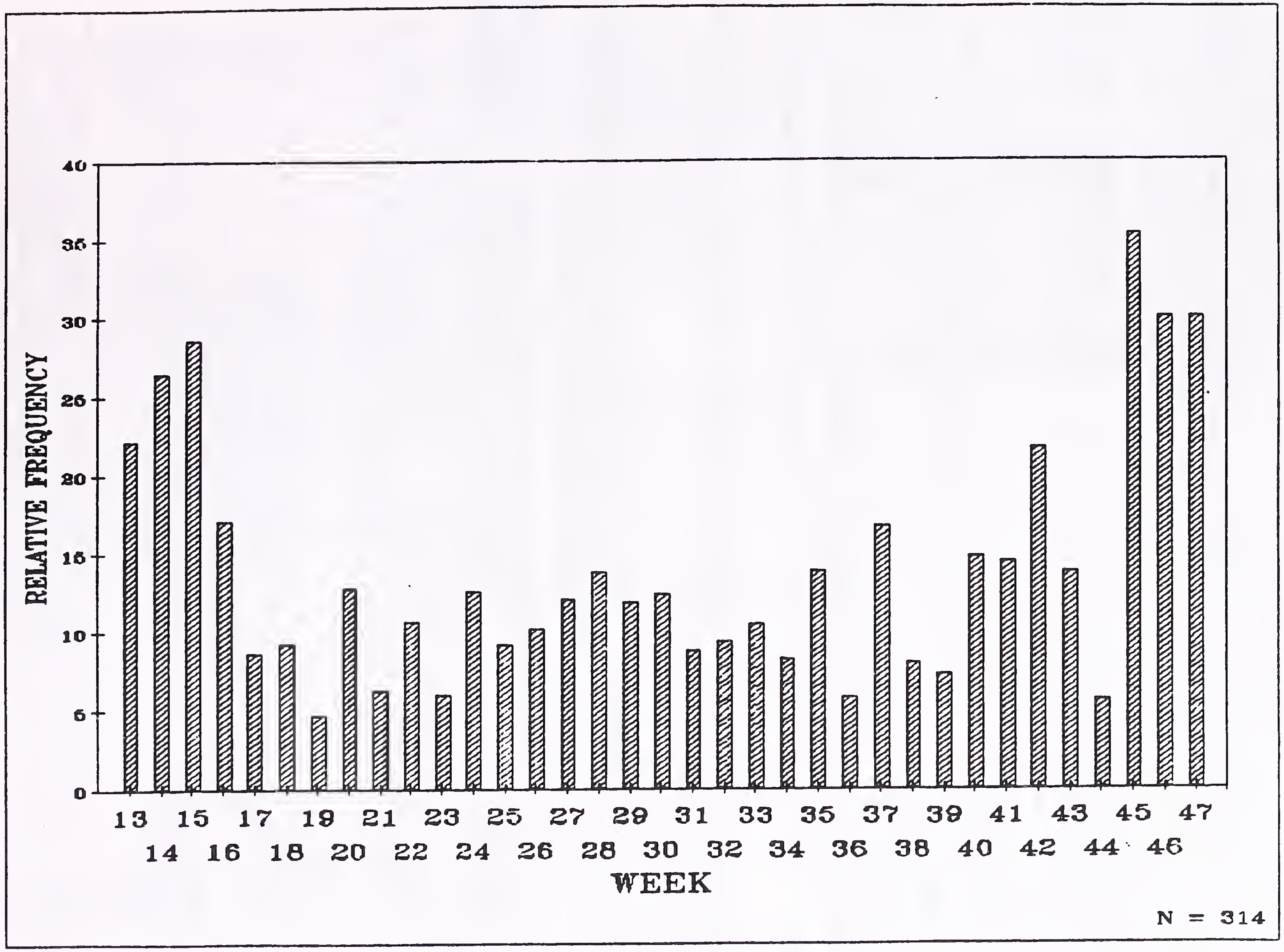


Figure 72. Grizzly bear use of open timber by week.

Table 46. The frequency of grizzly bear activities observed within the open timber component annually and seasonally, 1977-87.

Activity	Spring	Summer	Fall	Annual
Carrion	3	0	4	7
Grazing	1	3	0	4
Digging roots	0	8	4	12
Digging pine nuts	3	1	17	29
Digging small mammals	0	1	0	1
Insect feeding	3	3	3	9
Feeding on berries	0	6	2	8
Other feeding	1	2	1	4
Bedded	16	9	5	30
Travelling	15	10	7	32
Mating/courting	6	0	0	6
Denning	27	0	25	51
Other non-feeding	2	0	0	2

Detailed results from vegetation plots conducted in this component are presented in Appendix F.

Table 47. Summary of data from vegetation plots (N=18) taken at radio locations of grizzly bears within the timbered shrubfield habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	5	32.9	88.9
> 10 cm. dbh	5	15.4	88.9
Shrubs			
Tall	4	18.8	66.7
Medium	16	37.3	100.0
Low shrubs/vines	6	25.4	83.3
Ferns and allies	0	0.0	0.0
Graminoids	8	7.0	72.2
Forbs	58	43.5	100.0
Moss	-	3.9	22.2
Soil	-	3.5	88.9
Rock	-	1.4	83.3

The under story canopy in this component includes a well developed shrub layer with a predominantly forb ground layer. A considerable portion of the shrub layer was composed of either Alder, Vaccinium, or Shepheridia depending on the site. This component had the highest average canopy coverage of Vaccinium Globulare. One third of the forb canopy cover was beargrass. Important bear foods such as Heracleum, Erythronium, Osmorhiza, and Angelica were frequently found, but only occasionally in great abundance.

Timber shrubfields used by bears included 10 different habitat types. The Psme, Picea, lower Abla and upper Abla habitat type series are all utilized (Table 48).

Table 48. The frequency of habitat type series within the timber shrubfield component used by grizzly bears on the Rocky Mountain Front, 1977-87.

Habitat type series	Frequency			
	Spring	Summer	Fall	Total
Scree	0	0	0	0
PiFl	0	0	0	0
Psme	0	6	2	8
Picea	1	4	6	11
Lower Abla	5	49	24	78
Upper Abla/Pial	0	3	1	4
Pico	0	0	0	0
Other	0	0	1	1

Timbered shrubfields were utilized in the range of elevations from 1524 to 2286 m. (Figure 73). Most of the use was concentrated within the 1600 to 2000 m. range which represents a mid-slope condition in our study area. There was very little change in the distribution of elevation by season for use of this component. The mean elevation was not significantly ($P<0.05$) different for each season.

The aspect of timber shrubfields used by bears was generally on cool northerly facing slopes during the summer and fall periods (Figure 74). There was a clear increase in use of the warmer aspects in this component during the spring period. The advanced phenological development of these warmer aspects during the spring probably provided new plant growth on which these bears could forage.

The slope of timbered shrubfields gradually increased from spring to fall (Figure 75). The average slope of timbered shrubfields was 36% and was not significantly different from the average slope of closed timber components.

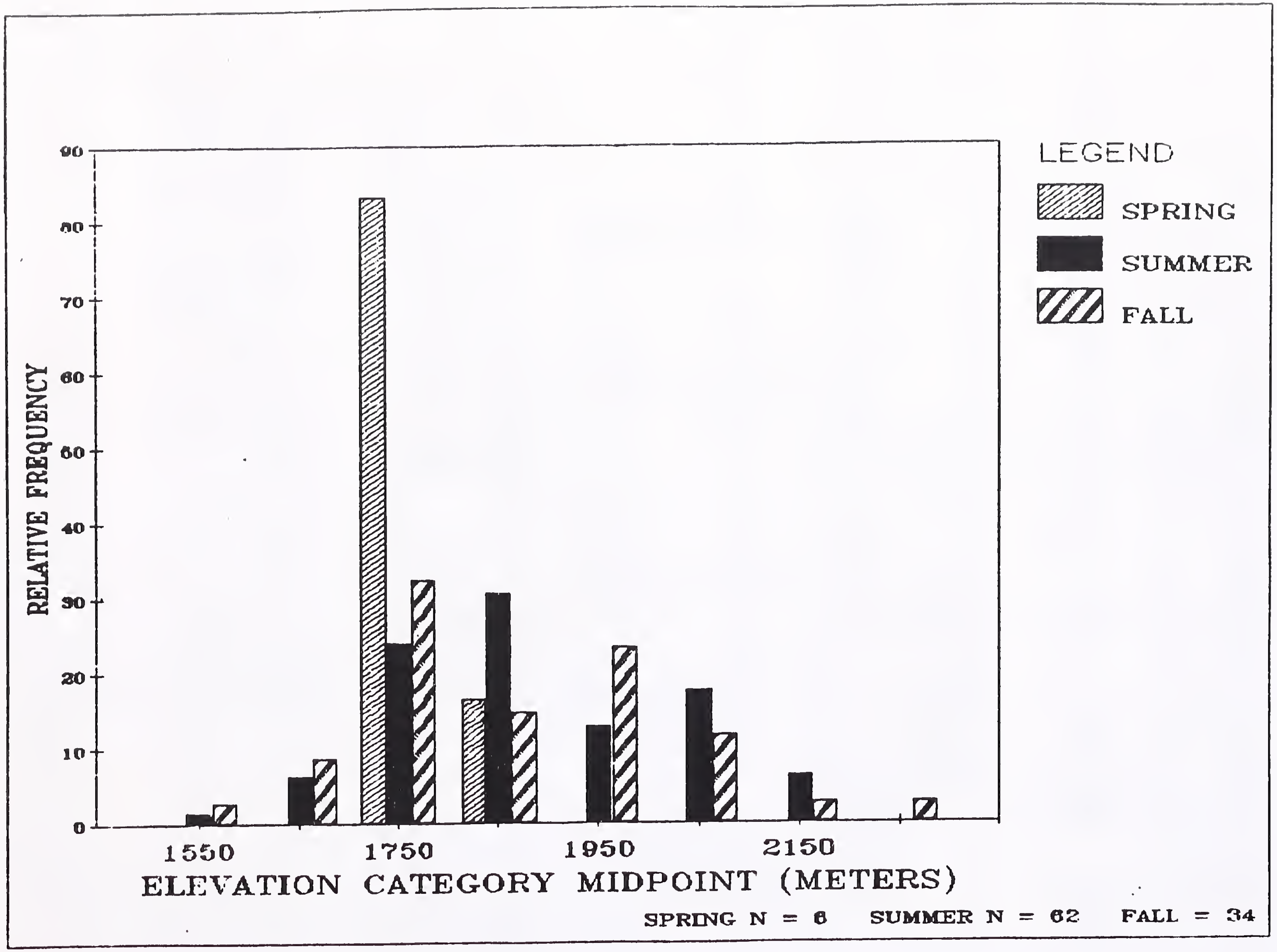


Figure 73. Grizzly bear use of timbered shrubfields by elevation.

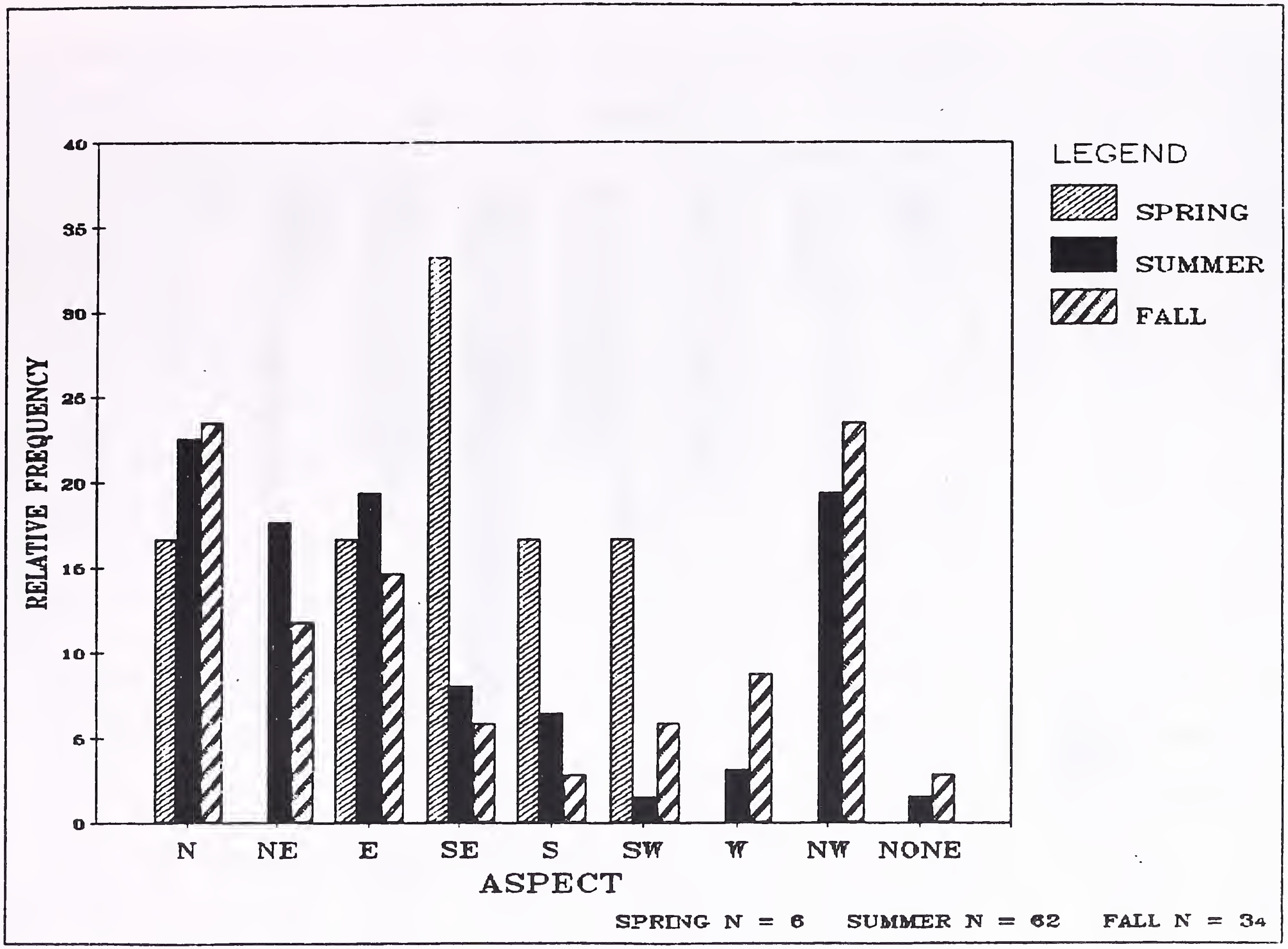


Figure 74. Grizzly bear use of timbered shrubfields by aspect.

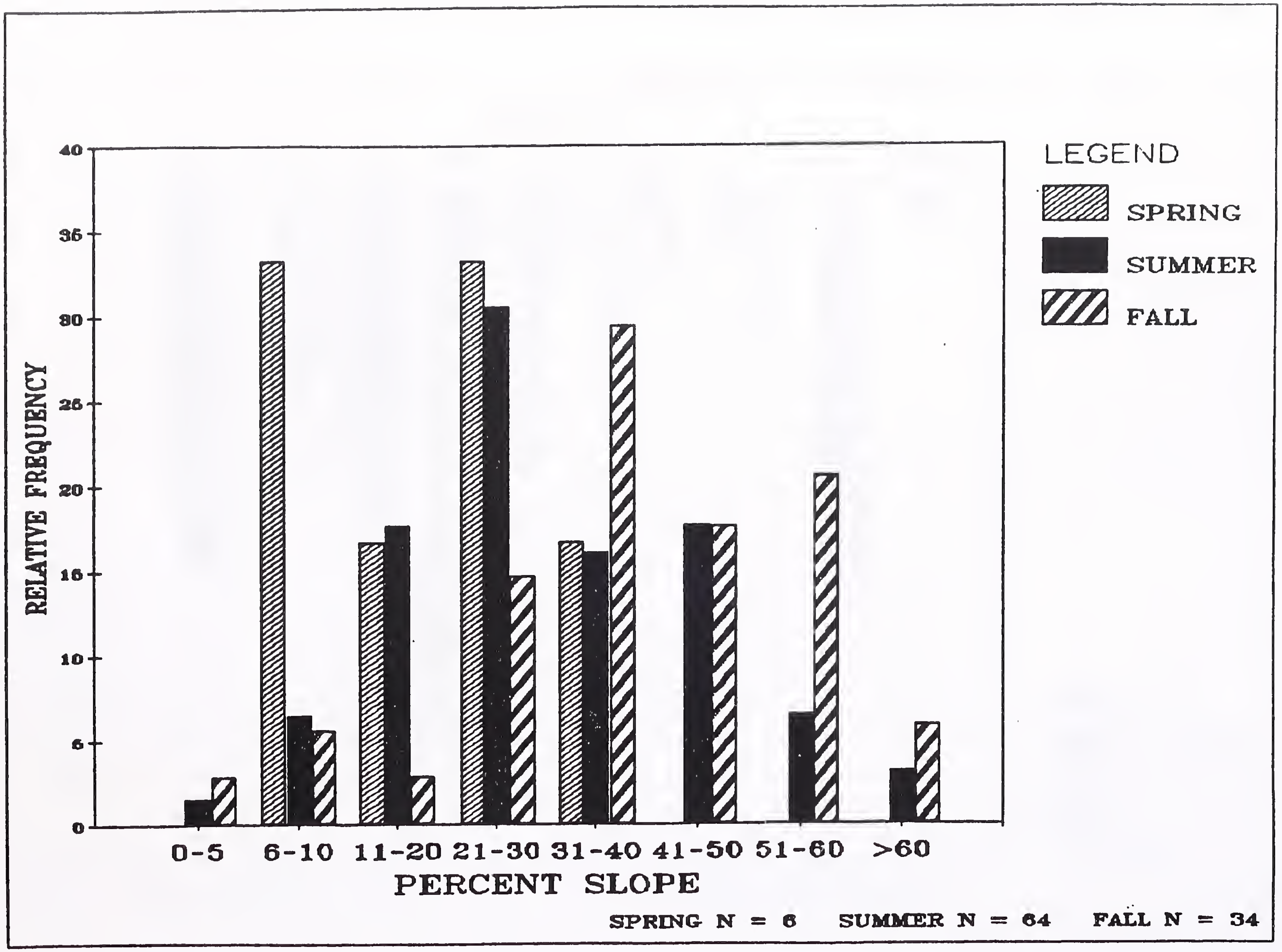


Figure 75. Grizzly bear use of timbered shrubfields by slope.

Few activity sightings were gathered in the timbered shrubfields primarily because of the difficulty of seeing through the plant canopy. The major bear activity observed was feeding on berries which was reported in 71% of the records. Other feeding activities observed were grazing and insect feeding. Non-feeding activities included bedding, traveling, and courting.

The principal use period for the timbered shrubfield component was from June until October (Figure 76). The peak of activity within this component was during the late summer and early fall when berry feeding occurred.

Limber Pine Savanna

The limber pine savanna component is an open timbered *Pinus Flexilis* dominated plant community with a canopy coverage of generally less than 30%. This component forms a foothills transition between the prairie grasslands of the lower elevations and the denser and cooler Pseudotsuga forests of the mid to lower slopes of the front. Detailed results of vegetation plots from this component are presented in Appendix F.

The average canopy coverage of the limber pine savanna was 24.3% (Table 49). This forest canopy was composed of either limber pine or douglas fir with an infrequent occurrence of subalpine fir. Limber pine had an average canopy coverage of 19.7% at these sites. Only four Pfister habitat types were identified within this component including the Pifl/Feid/Fesc, Pifl/Feid, Pifl/Juco, and Pifl/Agsp.

Table 49. Summary of data from vegetation plots (N=11) taken at radio locations of grizzly bears within the limber pine savanna habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	3	10.8	100.0
> 10 cm. dbh	3	13.5	81.8
Shrubs			
Tall	0	0.0	0.0
Medium	12	22.0	100.0
Low shrubs/vines	6	14.4	54.5
Ferns and Allies	0	0.0	0.0
Graminoids	10	26.4	100.0
Forbs	58	19.1	100.0
Moss	-	0.0	0.0
Soil	-	5.4	63.6
Rock	-	2.1	45.4

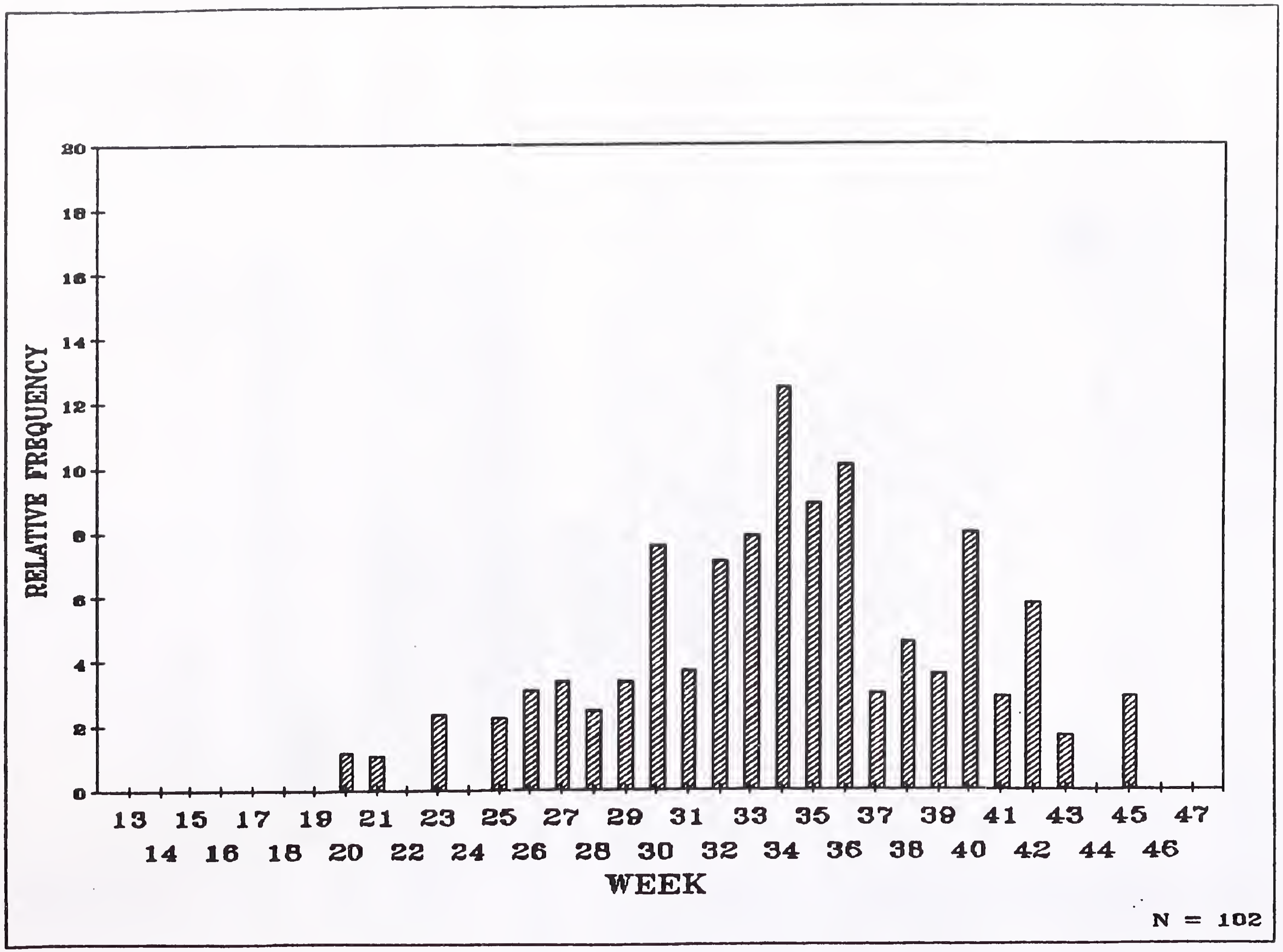


Figure 76. Grizzly bear use of timbered shrubfields by week.

The under story of the limber pine savanna was predominantly grass and forb mixed with a fairly well developed shrub under story. Most of the shrub under story was either Shepherdia, Arctostaphylos, or Juniper. Grass and forb species were primarily dry site species not particularly important as bear foods.

Limber pine savanna components used by grizzly bears ranged in elevation from 1300 to 1950 m. (Figure 77). The components occurrence was very limited in elevational range thus there was little difference between the mean elevation of use for each season.

Slopes of the limber pine savanna's ranged from flat to 60% but were on the average only 17%. The mean slope was significantly lower during the summer (9.8%) than spring (22.8%) or fall (19.0%). The slopes at 87.6% of the sites within this component were less than 30%.

Aspects of limber pine sites used by grizzly bears were mostly northerly or with limited slope or aspect (Figure 78), however, there was increased use of the southerly warm and dry sites during the spring.

Grizzly bear use of this component is highest during the spring and summer (Figure 79). In spring bears were observed bedding or traveling often in this component. During the summer the Shepherdia was often producing berries which the bears utilized.

The two most commonly observed feeding activities within this component were insect feeding and feeding on berries (Table 50). Little use of limber pine nuts was detected during this study. The one case we did observe involved a female with cubs near her bed site. Nonfeeding activities such as bedding and traveling were more commonly observed within this component. The cover value of this component is considerable especially during the spring as bears are ranging in the lowland habitats.

Riparian Complex

This component may be timbered, open timbered, or open sites which are hydrologically active. They are the narrow strips of habitat along permanent rivers, streams, or any water channel carrying free flowing water. Water flow can be perennial or ephemeral. This riparian habitat is narrow and linear in shape exhibiting a very abrupt cross sectional moisture gradient. Vegetation can be highly variable and complex. Details from the vegetation plots recorded in the riparian complex component are presented in Appendix F.

The average tree canopy coverage for the riparian complex was 19.2% (Table 51). The tree canopy was dominated by either Picea, Psuedotsuga, or Abies. The tall shrub cover was Alder or Willow. The medium shrubs were variable. This component contained the

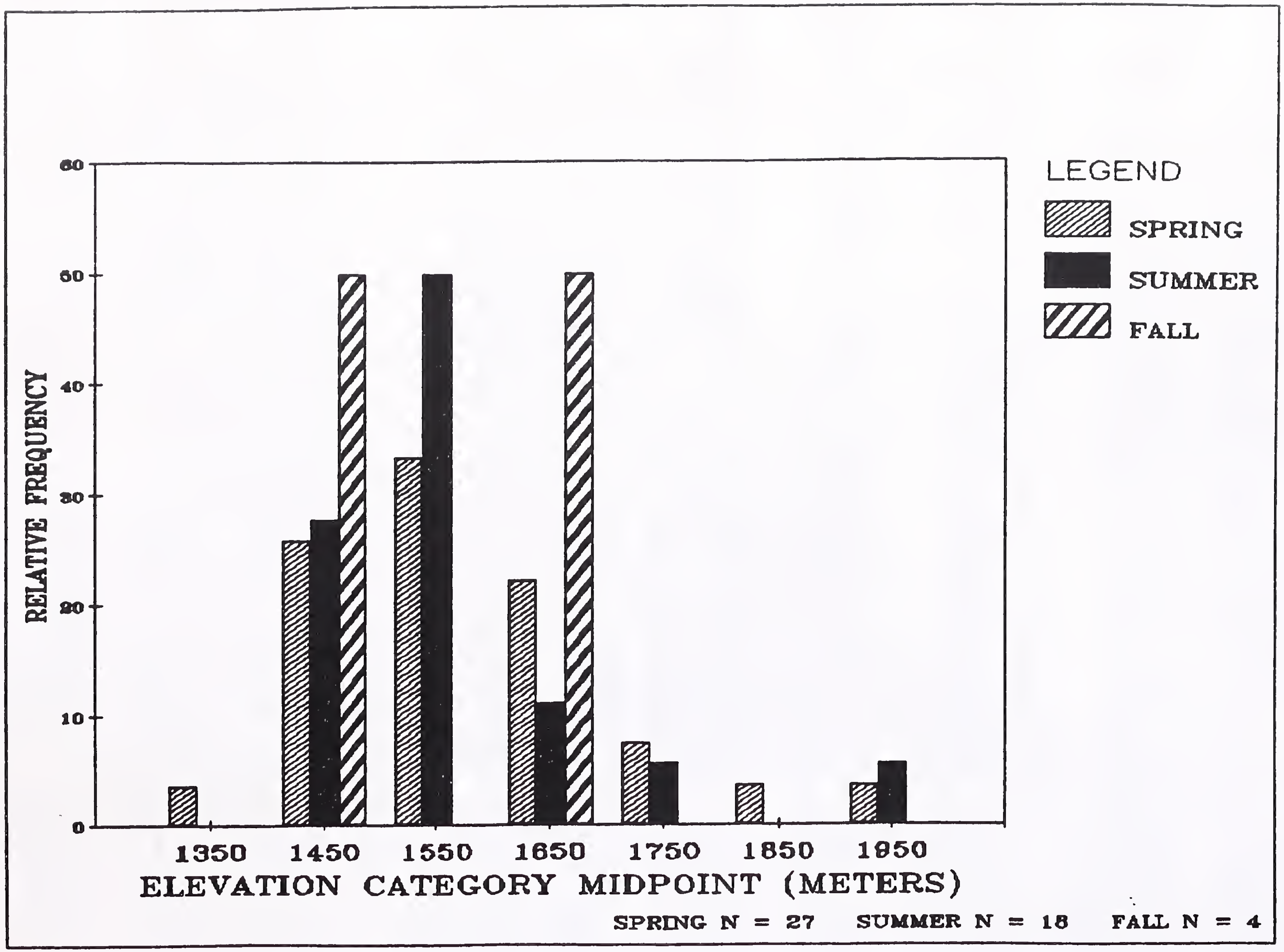


Figure 77. Grizzly bear use of limber pine savanna by elevation.

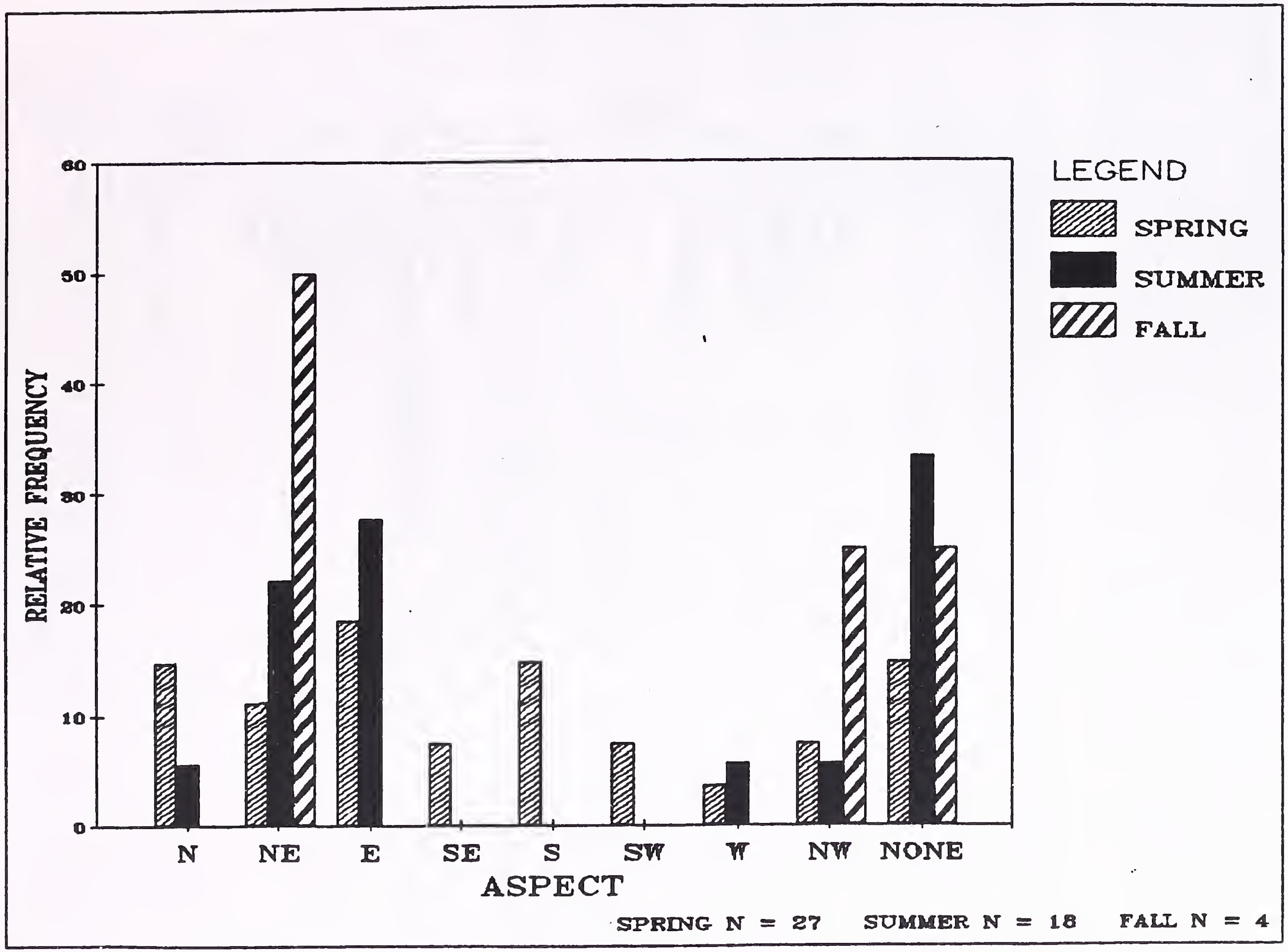


Figure 78. Grizzly bear use of limber pine savanna by aspect.

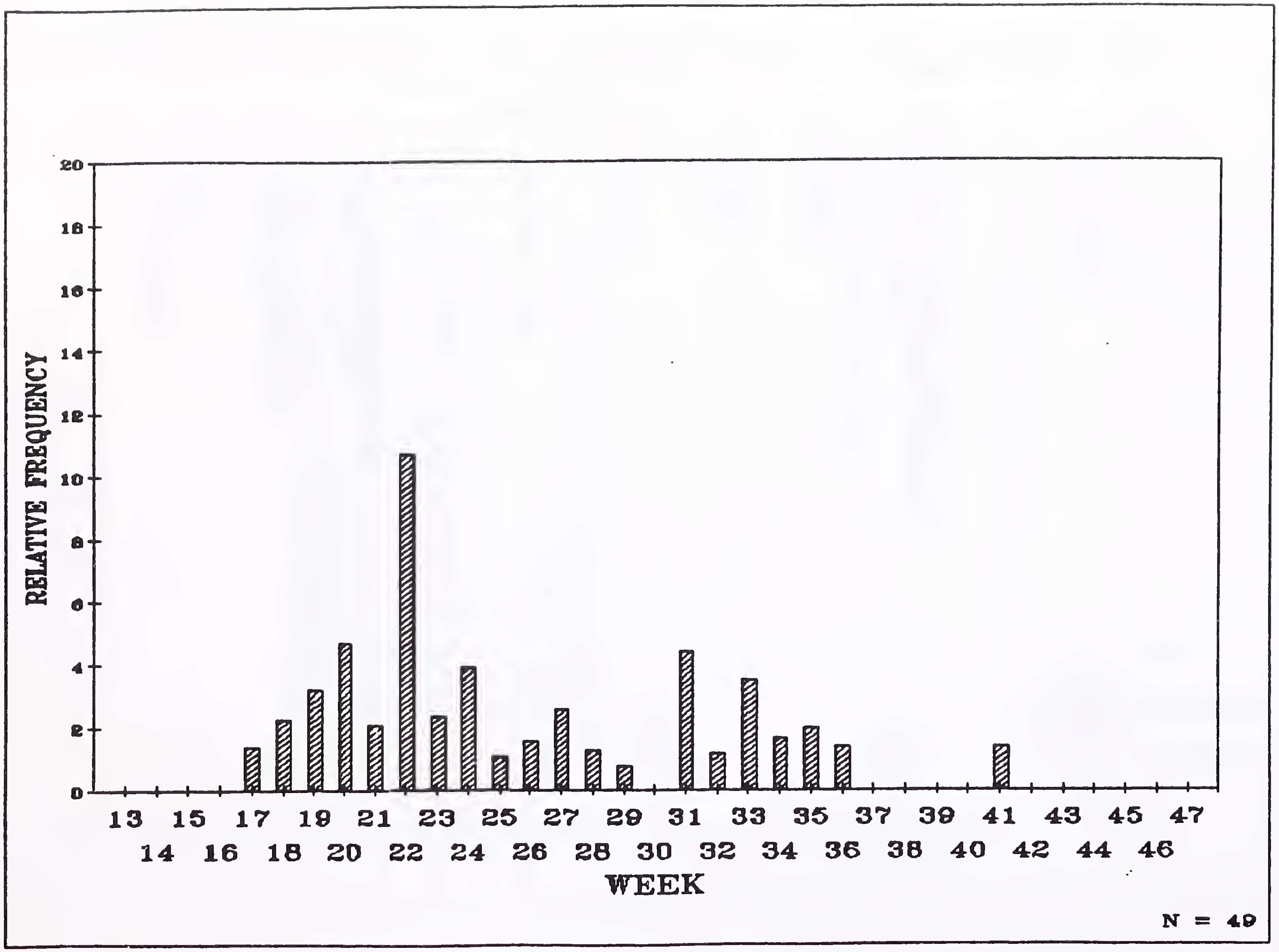


Figure 79. Grizzly bear use of limber pine savanna by week.

largest average canopy cover value for the fern and fern allies group which was principally composed of Equisetum. Moist site forbs such as Angelica, Osmorhiza, and Heracleum were common and abundant in this component. Graminoids were not particularly abundant in this component. The average canopy of rocks in our sample were high but mostly because of one site which had streamside rubble deposited during a prior flood.

Table 50. The frequency of grizzly bear activities observed within the limber pine savanna component annually and seasonally, 1977-87.

Activity	Spring	Summer	Fall	Annual
Carrion	1	0	0	1
Digging roots	0	1	0	1
Digging pine nuts	1	0	0	1
Digging small mammals	2	0	0	2
Insect feeding	2	2	0	4
Feeding on berries	0	4	0	4
Bedded	6	4	1	11
Travelling	12	3	3	18
Mating/courting	1	0	0	1

Table 51. Summary of data from vegetation plots (N=5) taken at radio location of grizzly bears within the riparian complex habitat component,1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	4	17.6	83.3
> 10 cm. dbh	3	5.9	83.3
Shrubs			
Tall	3	18.0	100.0
Medium	11	20.4	100.0
Low shrubs/vines	2	3.1	66.7
Ferns and Allies	1	23.1	83.3
Graminoids	5	8.4	100.0
Forbs	39	45.8	100.0
Moss	-	0.4	16.7
Soil	-	2.6	33.3
Rock	-	17.1	50.0

Eight different habitat types were used by bears within the riparian complex component. These primarily include types from the Psme, Abla, and Picea series. Locations were also found within four riparian community types including the Populus tremuloides/ Salix, Salix/grass, Salix/Carex and Salix/Betula.

The use of this component ranged in elevation from 1273 to 2298 m. and averaged 1648 m. Elevations of the sites used increased slightly from spring to fall but not significantly ($P>0.05$). Most of the use of the riparian complex was concentrated below 1800 m. in elevation (Figure 80).

The riparian complex component used by bears was highly variable in slope and aspect. Fifty-two percent of the radio locations within this component were at sites with no discernable aspect and slopes less than 10%. Percent slope at all sites ranged from 0 to 50% and averaged 13.4%. Sample size of the data was too small to develop meaningful frequency histograms.

Use of this component was sporadic but ranged through all seasons (Figure 81). Fifty-six percent of the radio location within this component were recorded during summer. This is the season when upland vegetation becomes desiccated.

Feeding activities observed within this component included grazing, pine nut digging, digging small mammals, insect feeding and feeding on berries. The vegetation structure and season of use suggest that grazing and berry feeding are probably important activities taking place within this component. Our sample is to small to give proper weight to activities within this component. Nonfeeding activities observed were bedding and traveling.

Populus Stands

Populus stands are deciduous forests where Populus tremuloides or Populus trichocarpa are the dominant tree species in the over story canopy. Populus stands occur from low lands to mid-slopes of the mountain front. Soil conditions range from dry sandy soils, to moderately wet clays and loams, and into silted soils with standing to slow moving water at the surface. Average canopy coverage of trees was 32.4% with 30% attributable to Populus species (Table 52). A detailed summary of vegetation composition for the Populus stands is presented in Appendix F.

Populus stands are rich in species diversity. Under story shrub species composition range with the moisture conditions and included Rosa, Symphoricarpos, Betula or Salix. This component has a rich forb understory with important bear foods such as Equisetum, Taraxacum, Erythronium, Heracleum, Osmorhiza, and Angelica which are common and relatively abundant.

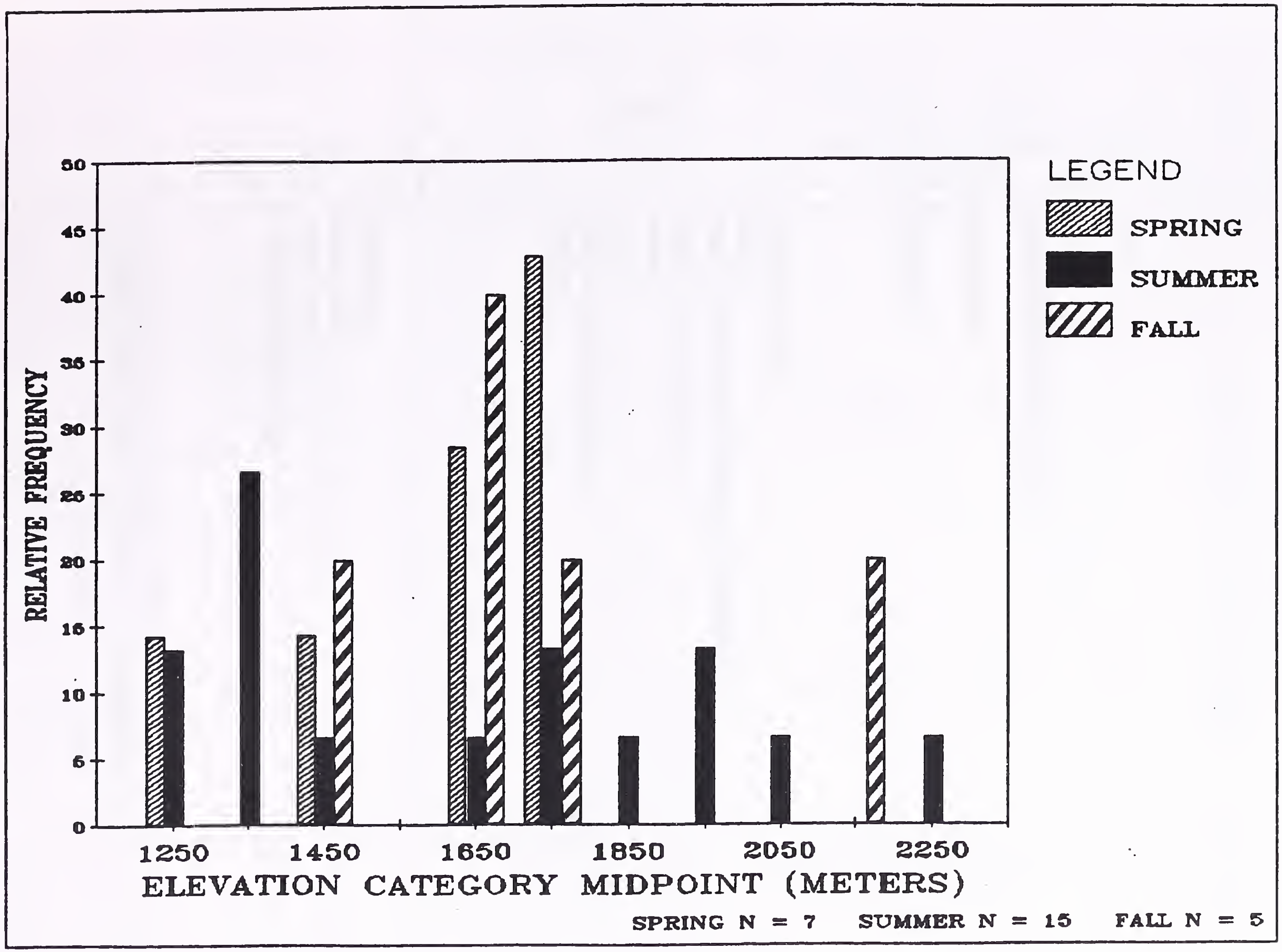


Figure 80. Grizzly bear use of riparian complex by elevation.

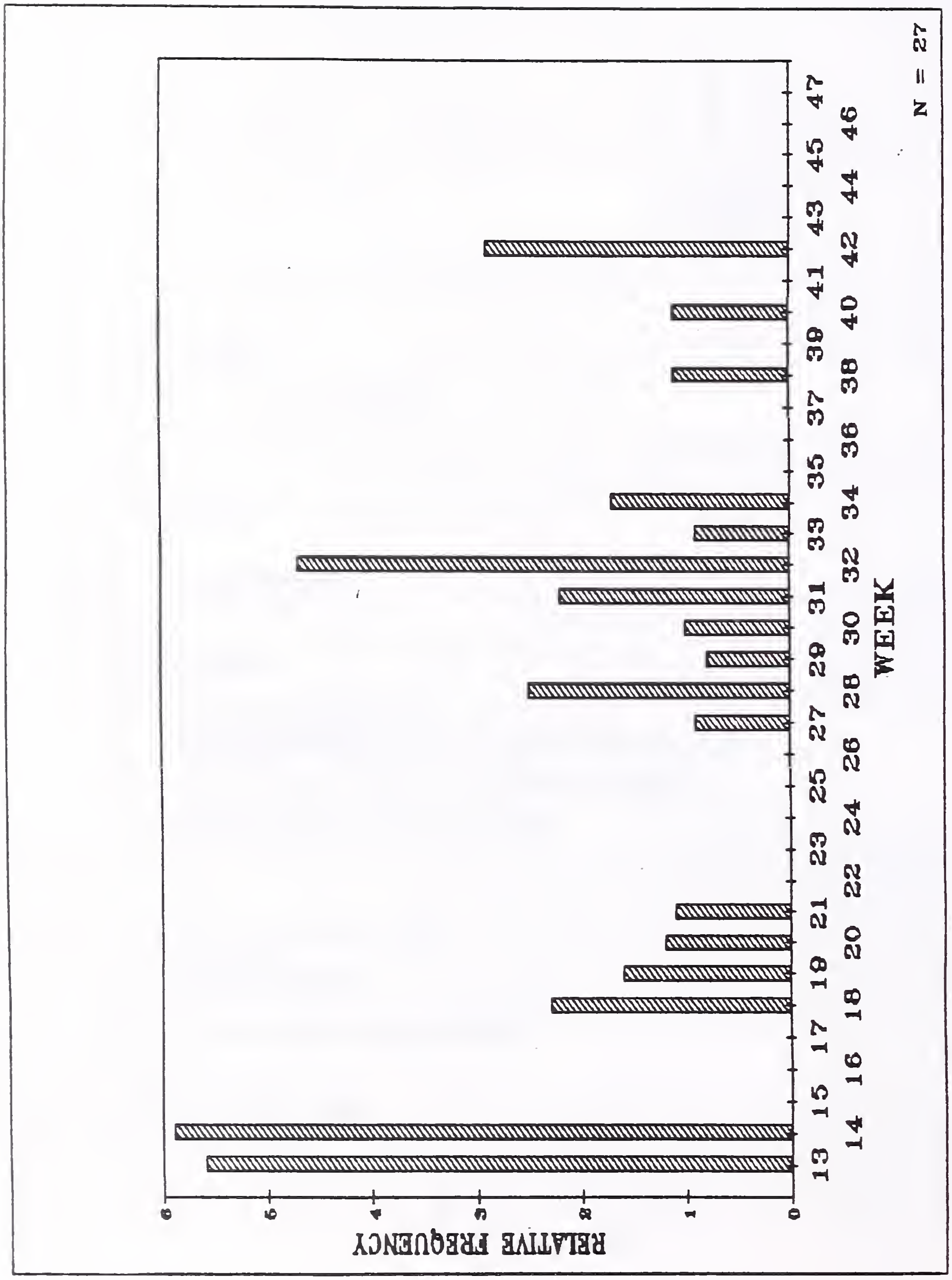


Figure 81. Grizzly bear use of riparian complex by week.

Table 52. Summary of data from vegetation plots (N=60) taken at radio locations of grizzly bears within the Populus Stand habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	7	19.3	91.7
> 10 cm. dbh	8	13.7	90.0
Shrubs			
Tall	6	23.1	81.7
Medium	18	18.0	96.7
Low shrubs/vines	9	1.2	38.3
Ferns and Allies	3	6.6	45.0
Graminoids	18	16.0	98.3
Forbs	108	22.0	100.0
Moss	-	0.1	10.0
Soil	-	4.1	61.7
Rock	-	1.0	21.7

The populus component occasionally was classified into Pfister habitat types when coniferous tree canopy was present. Otherwise, the component was classified as a Populus tremuloides or Populus trichocarpa dominated stand. The understory was divided into stands with Salix well represented or those without Salix and Symphoricarpos present. Generally the Potre/Salix types were in the flat, basin areas with little or no slope. These are poorly drained and often had water on or near the surface. Potre/Sympho sites were usually much drier and on well drained moderately to gently sloping sidehills or dry flats. Populus trichocarpa types were confined to areas near water courses on generally concave or flat topography.

Grizzly bear use of the populus stands was recorded in 3 habitat type series and 4 riparian community types (Table 53). Pfister types cumulatively represented only 1.5% of the total use of the Populus stands. All other use was within riparian community types visibly lacking coniferous tree cover and, therefore, not suitably classed with the Pfister forest habitat type system.

The wetter site Populus stand components were used by grizzly bears more frequently than drier site stands. Use of the drier Populus tremuloides stands was predominantly during the spring when forage is attractive to bears until summer heat desiccates the vegetation on these sites. The highest relative frequency of use in the wetter Populus tremuloides stands was during the summer when other sites are dried and forage value has been reduced. The wetter

Populus trichocarpus stands were used primarily during the fall. These types were prime chokecherry and serviceberry producing habitats.

Table 53. The frequency of habitat type series within the populus stand component used by grizzly bears on the Rocky Mountain Front, 1977-87.

Habitat type series	Frequency Spring	Summer	Fall	Total
PiFl	0	1	0	1
Psme	2	3	0	5
Lower Abla	1	0	0	1
Potre/Salix	104	114	56	274
Potre/Sympho	46	15	9	68
Potri/Salix	17	19	42	78
Potri/Sympho	3	4	1	8

Populus stands used by grizzly bears ranged from 1097 to 1920 m. Eighty-five percent of the use was below 1600 m. in elevation (Figure 82). Mean elevations for each season were not significantly different. There was a broad range of elevations used during the spring whereas during the summer and fall the use was more concentrated in the lower elevations. It is during this period that berries were available in the Populus stands.

The aspect for 75.5% of the populus stands used by grizzly bears was classified as none indicating very little slope. The remaining sites used were predominantly on northerly to easterly slopes.

The mean slope for all sites was 6.1% with a range of 0 to 50%. Populus stands with slopes of less than 20% comprised 93.3% of the sites. Mean slope of sites decreased significantly from a mean of 8% in spring to a mean of 3.5% for the fall.

The most important feeding activities observed within this component were feeding on carrion, grazing, insect feeding, and feeding on berries (Table 54). Feeding on carrion and grazing are the two significant activities during the spring while berry feeding is prevalent during the fall. Grizzly bear feeding activities are consistent with the vegetation composition recorded within this component. The significant amount of carrion feeding observed within the populus stands suggests that the cover value of this component may be important in accessing available carrion. The inclusion of several boneyards within this component also resulted in the increased observation of this activity. Nonfeeding activities included bedding and traveling both of which are enhanced by the cover values of this densely vegetated component.

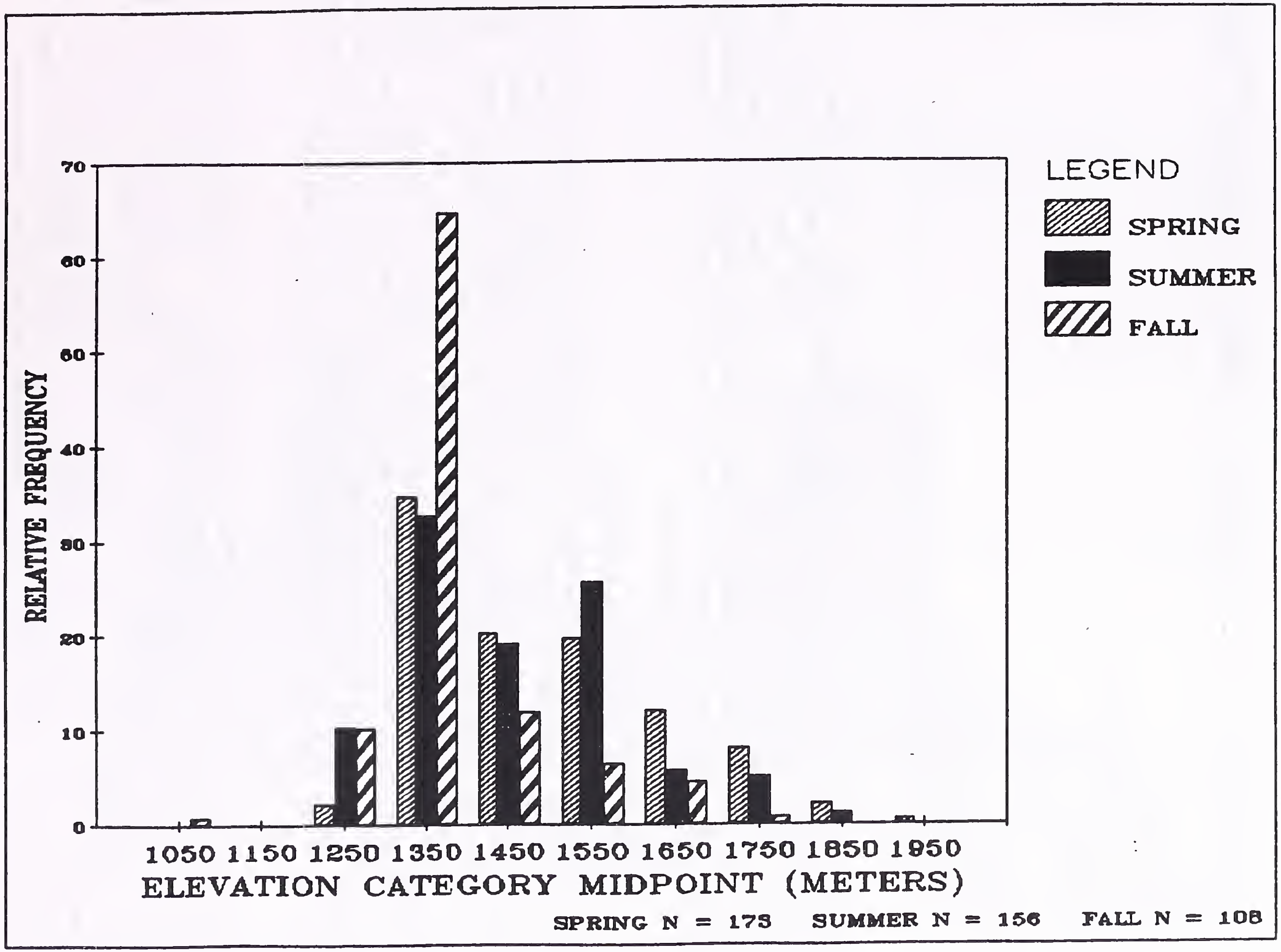


Figure 82. Grizzly bear use of populus stands by elevation.

Table 54. The frequency of grizzly bear activities observed within the Populus stand component annually and seasonally, 1977-87.

Activity	Spring	Summer	Fall	Annual
Carrion	20	5	12	37
Grazing	11	6	0	17
Insect feeding	4	5	1	10
Feeding on berries	0	10	7	17
Garbage	1	0	0	1
Other feeding	4	9	6	19
Bedded	43	43	30	116
Travelling	10	4	5	19
Mating/courting	4	0	0	4

Grizzly bear use was observed within this component from den emergence until denning (Figure 83). Two prominent peaks in use were noted. The first intensely used period was during the spring when foraging for grass and forbs and carrion feeding were prevalent. A second peak in use occurred during the late summer and fall when berry feeding was the major activity of bears using the component.

Riparian Shrub

The riparian shrub component is defined as a perennially wet site with extensive areas where shrub species occupy the largest portion of the over story. Tree over story is generally less than 2%. This component is characterized by wet seeps, bogs, fens, glades, or marshes where shrubs such as Salix or Betula commonly dominate. The riparian shrub component occurs from lowlands to foothills commonly adjacent to streams, rivers, lakes, or ponds. Generally the shrub species form extensive stands integrating moderately wet perimeters adjacent to grasslands into very wet centers where the shrub over story lessens and bogs, seeps, or standing water occur. A detailed summary of vegetation plot data is presented in Appendix F.

The shrub cover is predominantly Salix and Betula species which form a tall (7-8 ft.) canopy (Table 55). Medium height shrubs such as Prunus and Amelanchier are common. The ground understory is a mix of grass and forbs. Carex and grasses common to wet environments form the graminoid cover. Forbs which are recognized as important bear foods such as Heracleum, Erythronium, and Angelica are relatively abundant. The highest average canopy coverage of *Heracleum lanatum* was found in this component. Equisetum is also commonly associated with this component.

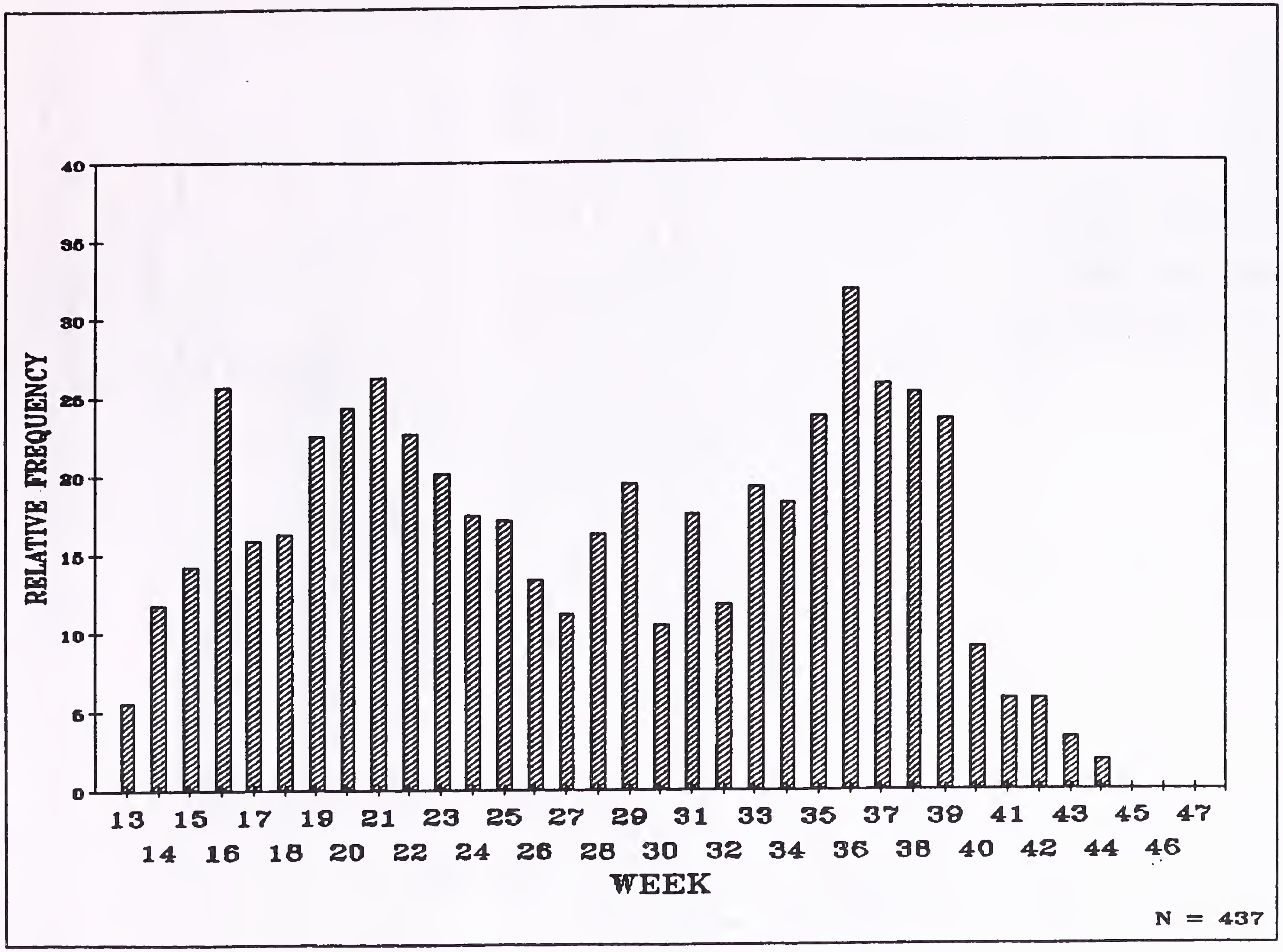


Figure 83. Grizzly bear use of populus stands by week.

Table 55. Summary of data from vegetation plots (N=51) taken at radio locations of grizzly bears within the Riparian shrub habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	2	0.1	13.7
> 10 cm. dbh	2	1.1	19.6
Shrubs			
Tall	4	55.1	100.0
Medium	14	7.8	96.1
Low shrubs/vines	4	0.1	15.7
Ferns and allies	3	3.3	62.7
Graminoids	15	21.6	98.0
Forbs	94	20.3	100.0
Moss	-	0.4	15.7
Soil	-	1.7	17.6
Rock	-	0.3	7.8

The riparian shrub component was further classified into five types including the Salix/Carex, Salix/grass, Salix/Betula and Betula/Carex types. The major shrub species in the canopy determined the initial classification. Sites dominated by Betula or co-dominated by Betula were differentiated from the Salix dominated types. Moisture conditions generally determined the vegetative cover within these classifications. The Salix/grass community type was drier than the Salix/Carex community. Betula/Carex types were drier than the Salix/Betula.

Bears used five riparian community types within the riparian shrub component (Table 56). Picea conifer cover was present in two sites indicating a Pfister habitat type may apply. All four riparian community types were used significantly during the spring and early summer when bears were grazing on the grass/sedge and forb under stories. These mesic riparian community types showed sustained use continuing well into the fall. The Salix/Betula type was used mostly during the late summer and fall when fruits of the chokecherry and serviceberry became available. Potre/Salix community types were identified near the ecotone between Populus stands and riparian shrub habitat components. These sites were predominantly shrub covered but occasionally supported encroachment by populus trees.

Use of the riparian shrub component occurred in the elevational range of 1225 m. to 1987 m. (Figure 84). Ninety-eight percent of

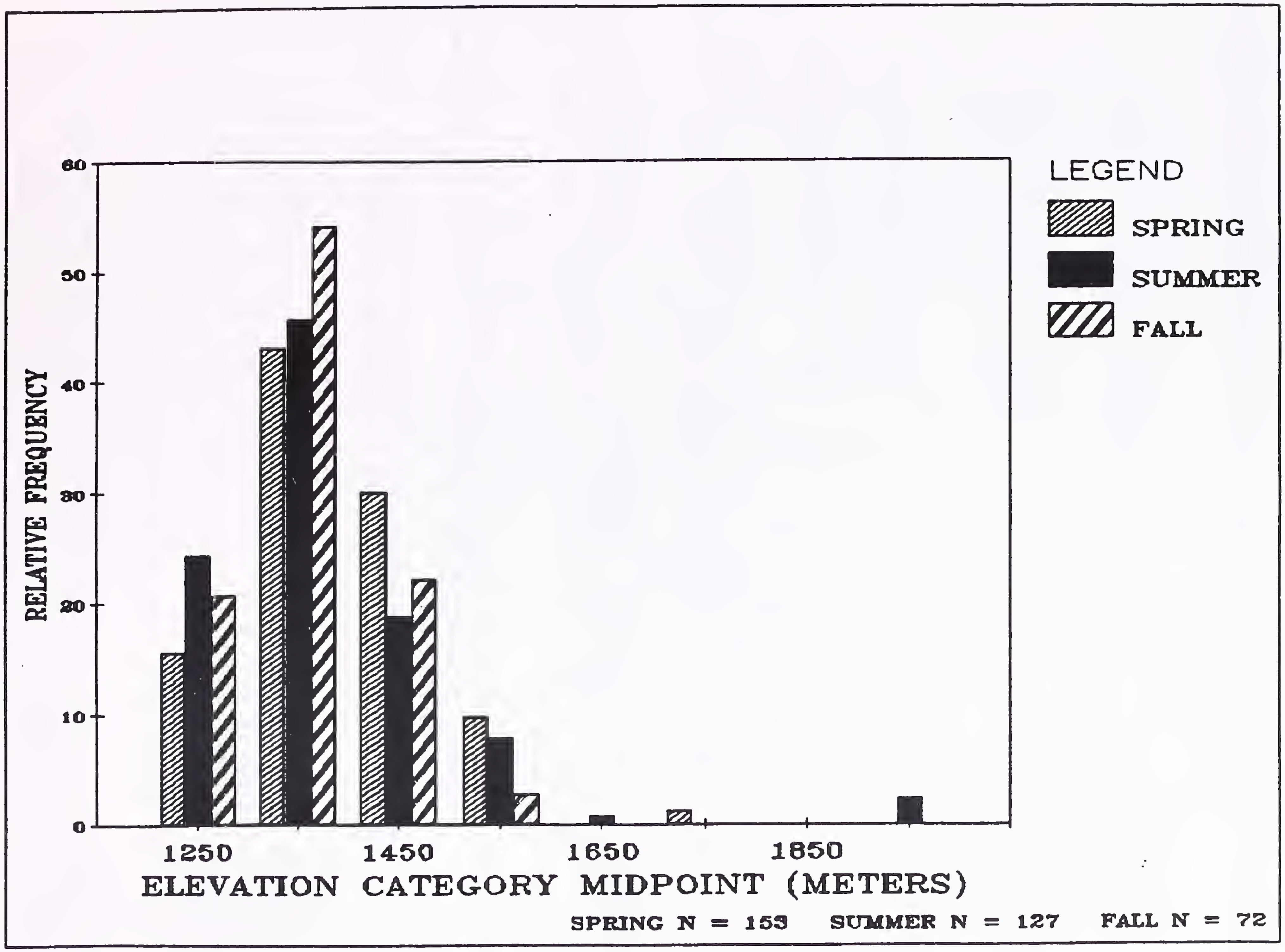


Figure 84. Grizzly bear use of riparian shrub by elevation.

the use was at elevations less than 1600 m. There was no significant shift in the distribution of elevation between seasons.

Table 56. The frequency of habitat type series within the riparian shrub component used by grizzly bears on the Rocky Mountain Front, 1977-87.

Habitat type series	Frequency Spring	Summer	Fall	Total
Picea	1	1	0	2
Potre/Salix	1	2	3	6
Salix/Carex	76	53	22	151
Salix/grass	21	18	10	49
Salix/Betula	52	50	36	138
Betula/Carex	2	3	1	6

Aspect and slope did not play a major role in the occurrence of use in the riparian shrub component. Average slope was 2.6% with 93.5% of the sites with slopes less than 5%. With a limited slope, aspects were not discernable in 93.5% of the sites. Only a few sites with low slopes on benches of the foothill regions had discernable aspects. These were all generally north,east, or south facing along the front range of the mountains.

The most commonly observed feeding activities within this component were feeding on carrion, grazing, and feeding on berries (Table 57). Bedding and traveling were the principal non-feeding activities observed.

Table 57. The frequency of grizzly bear activities observed within the riparian shrub component annually and seasonally, 1977-87.

Activity	Spring	Summer	Fall	Annual
Carrion	10	10	12	32
Grazing	19	2	2	23
Digging small mammals	1	1	0	2
Insect feeding	2	3	1	6
Feeding on berries	0	8	7	15
Garbage	1	0	0	1
Other feeding	2	4	0	6
Bedded	47	33	21	101
Traveling	18	11	4	33
Mating/courting	3	0	0	3
Other non-feeding	1	1	0	2

The riparian shrub component was used from den emergence until den entrance (Figure 85). Use of this component was most prominent during the foraging season in spring and again in late summer and early fall. The peaks in spring correlate with plant phenology and development within this component. Fall use is related to fruit production.

Shrubfields

Shrubfields are open to sparsely timbered (canopy coverage of trees less than 10%) sites dominated by extensive stands of shrubs occurring from the low mountain slopes to high elevations on moderate to steep slopes. Repeated wildfire, timber harvesting, or topo-edaphic influences are factors responsible for the creation and maintenance of these seral communities.

Individual or small groups of trees may be found in shrubfields. Average canopy coverage of trees in the shrubfield component was 7.6% (Table 58). Most of the tree canopy coverage was in large dbh trees. Species composition for the shrubfield component is detailed in Appendix F.

Table 58. Summary of data from vegetation plots (N=8) taken at radio locations of grizzly bears within the shrubfield habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	4	0.7	37.5
> 10 cm. dbh	6	8.1	75.0
Shrubs			
Tall	3	10.0	37.5
Medium	13	49.7	100.0
Low shrubs/vines	6	7.9	87.5
Ferns and allies	0	0.0	0.0
Graminoids	12	15.7	100.0
Forbs	14	37.8	100.0
Moss	-	0.0	0.0
Soil	-	2.9	75.0
Rock	-	3.9	62.5

The understory of the sites within the shrubfield component were dominated by medium sized shrubs such as Shepherida, Amelanchier, Alder, _Vaccinium globulare_ or low shrubs such as Arctostaphylos or _Vaccinium scoparium_. Grasses were relatively common but were

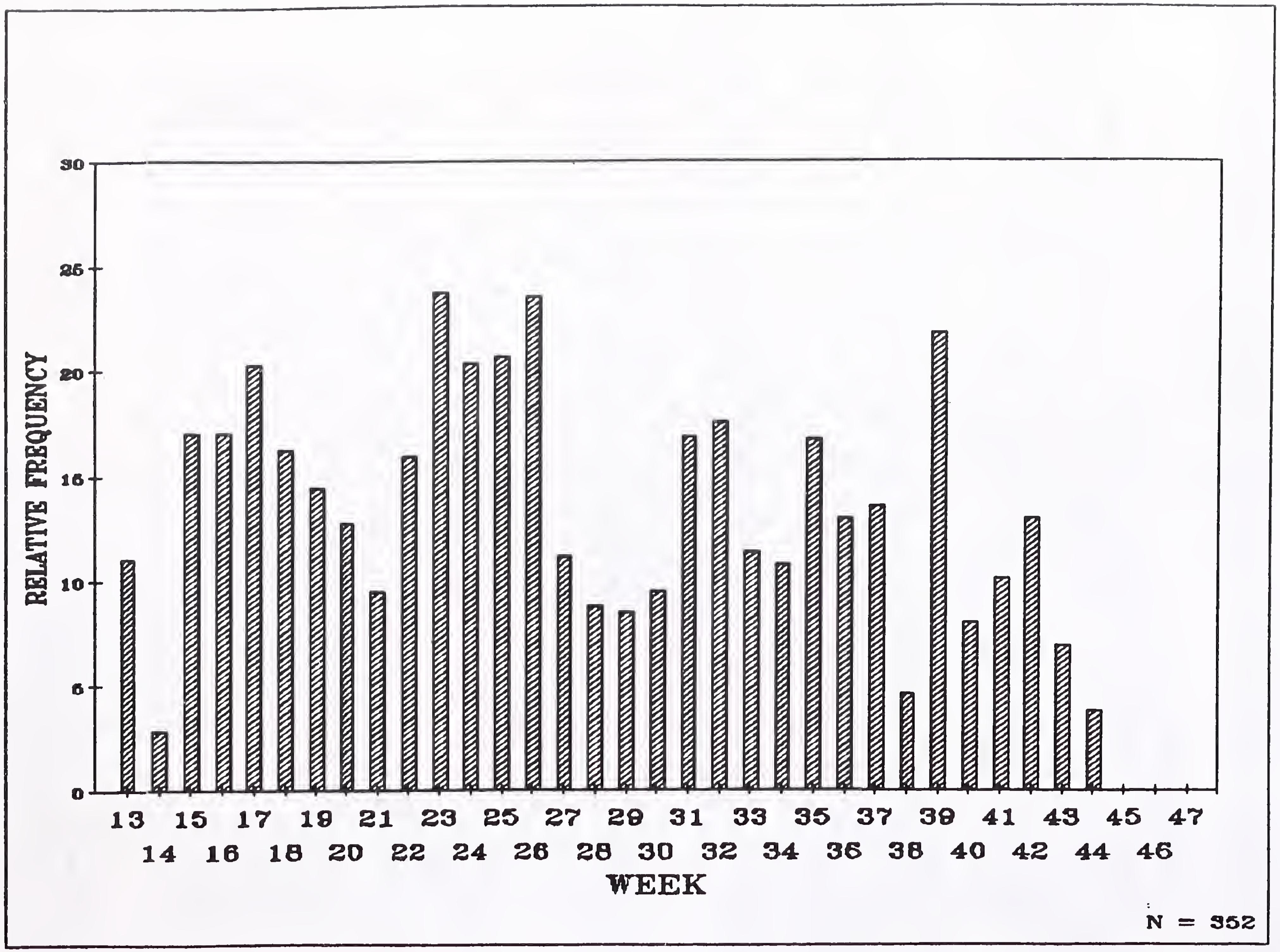


Figure 85. Grizzly bear use of riparian shrub by week.

predominantly dry site species such as Festuca and Agropyron. The forb understory was variable and included some bear food species such as Angelica and Heracleum in the understory of Alder shrubfields. Other shrubfields were generally composed of dry site forbs including Hedysarum which is dug for its root.

Shrubfields were classified into nine different Pfister habitat types and one grassland habitat type (Mueggler and Handl 1974) (Table 59). Approximately 87% of the radio locations classified within the shrubfield component were within the Abla series habitats.

Table 59. The frequency of habitat type series within the shrubfield component used by grizzly bears on the Rocky Mountain Front, 1977-87.

Habitat type series	Frequency			
	Spring	Summer	Fall	Total
Scree	0	0	0	0
PiFl	0	0	0	0
Psme	1	0	1	2
Picea	1	0	0	1
Lower Abla	0	24	6	30
Upper Abla/Pial	0	2	1	3
Pico	0	0	0	0
Grassland	0	0	2	2

Shrubfields used by bears ranged in elevation from 1219 to 2256 m. (Figure 86). With just two radio locations from the spring period we could only compare elevations for the summer and fall season. No difference existed between mean elevation for the summer and fall periods. Shrubfields used by bears were well distributed throughout the mid slope elevational range of our study area.

Aspect of shrubfields was variable and use was observed within each of the aspect categories. Data were insufficient to make seasonal comparisons.

Slopes of shrubfields used ranged from 0 to 75% and averaged 40.6%. Slopes in the categories from 11 to 60% comprised 89.5% of the locations. There was no difference in mean slope between summer and fall.

Only two activities were observed within the shrubfield component including feeding on berries and bedding. It is likely that more forb feeding was occurring under the dense canopy of alder shrubfields but was not detected. These particular shrubfields were predominantly found in the Badger-Two Medicine area and had a vegetation composition which would provide forage for bears

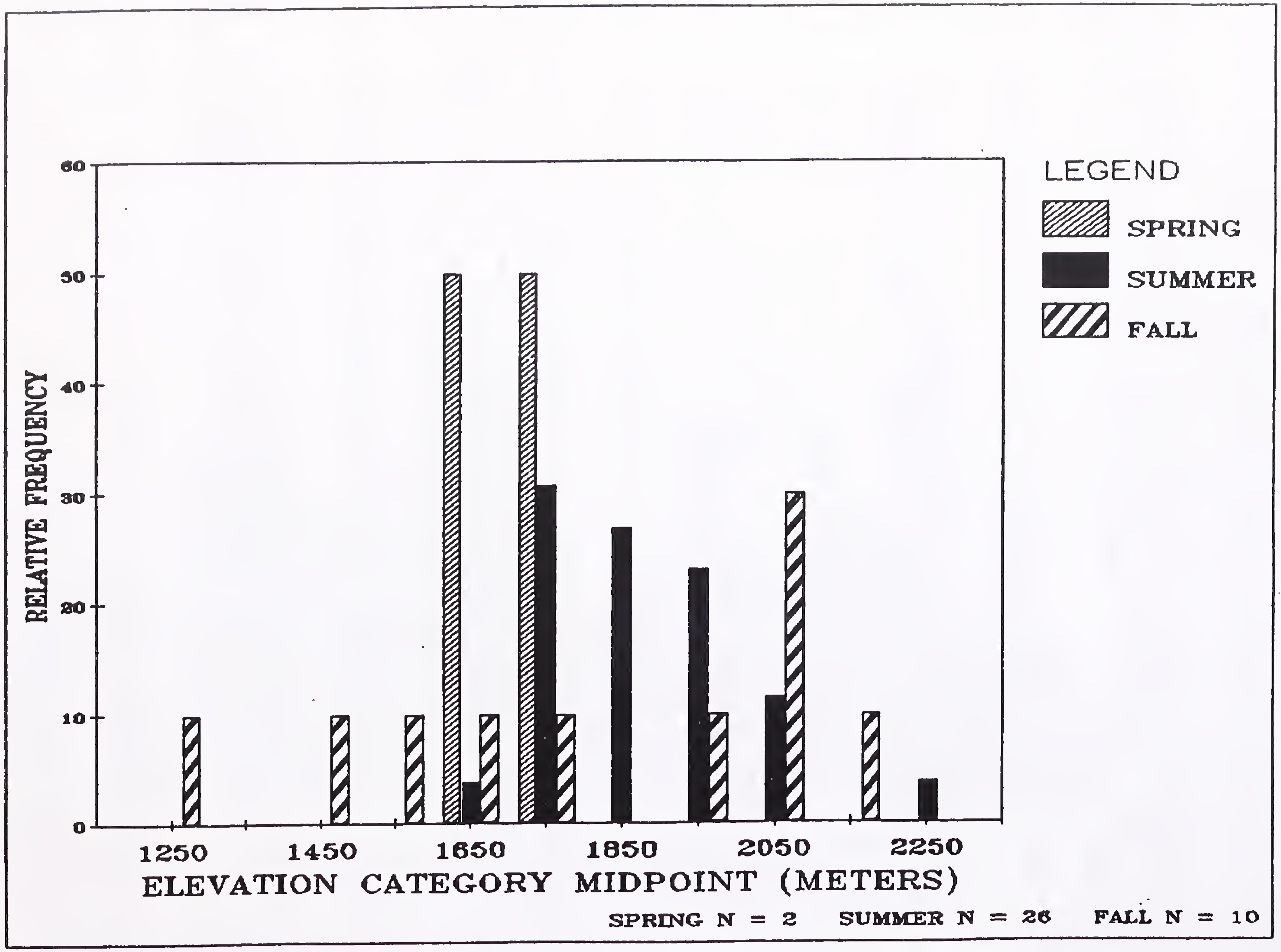


Figure 86. Grizzly bear use of shrubfields by elevation.

during spring and summer. Our radio sample was biased toward use of drier shrubfields to the south where berry feeding is the prime use.

Shrubfields were used from July until October (Figure 87). This is consistent with the berry feeding activities observed within this component. As mentioned above, the use in spring of the Alder shrubfield may be underestimated.

Snowchutes

Snowchutes are concave, very steep, linear, and open to sparsely timbered sites. They occur on mid to upper slopes where frequent snow movement limits vegetation development. Snowchutes often constitute the uppermost ephemeral stream channels of drainage systems. This component may exhibit a highly variable vegetation gradient along its length and cross sectional dimensions.

Data from snowchutes is somewhat limited along the front because only 39 radio locations were classified within this component and only two vegetation plots were conducted at sites used by grizzly bears. The Badger-Two Medicine area was the only region where persistent snow accumulations and slide activity provided snowchutes typical of other portions of western Montana. South of Birch Creek avalanche chutes were scoured and composed mostly of rock and rubble. Snow accumulations were not prevalent and slides occurred only on the steepest slopes. Vegetation developed slowly on most of these sites and the lack of sufficient canopy contributed to the dryness of many of the chutes. Wet site species were confined to narrow zones and patches along developing watercourses. Details from the vegetation plots from snowchutes are presented in Appendix F.

The average canopy of trees was only 1.5% and composed mostly of large diameter trees which have survived past slides (Table 60). Forbs and ferns were the dominant ground cover species. Bear foods such as Equisetum arvense, Angelica, and Heracleum were occasionally abundant. Rock and loose soil composed over a third of the ground cover.

Snowchutes used by bears were clustered in the elevational range from 1463 to 2469 m. (Figure 88). The mean elevation of use in snowchutes did not change between seasons.

The average slope of snowchutes was 51.2% with a range of 15% at the tail of chutes to 75% near the top. Slopes were predominantly above 30% during all seasons (Figure 89).

Over all, snowchutes used by bears were predominantly on the northerly and easterly aspects (Figure 90). Over 50% of the snowchutes used in spring were on warm aspects facing southeast. It may be that these slopes provided forage earlier than cooler

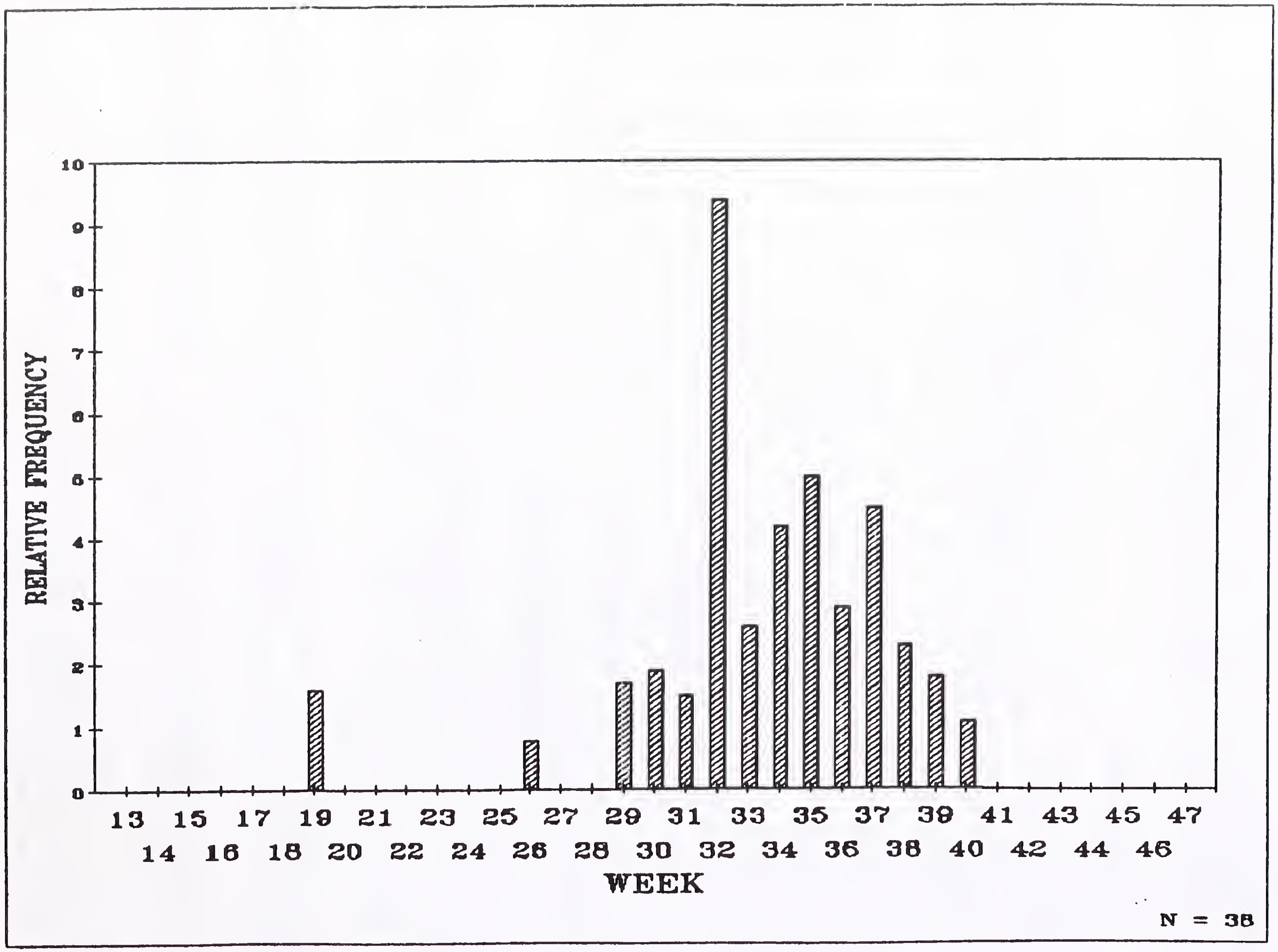


Figure 87. Grizzly bear use of shrubfields by week.

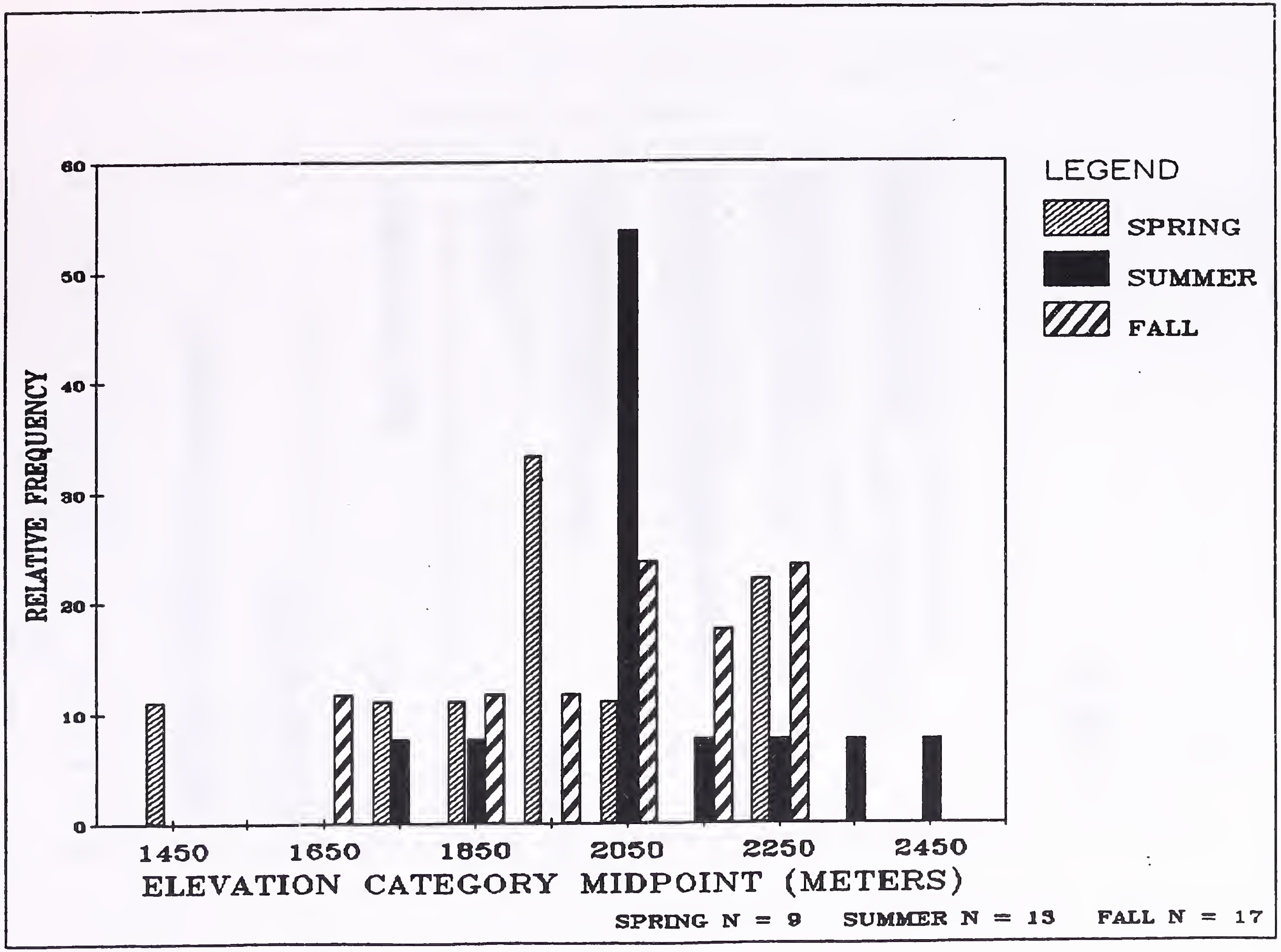


Figure 88. Grizzly bear use of snowchutes by elevation.

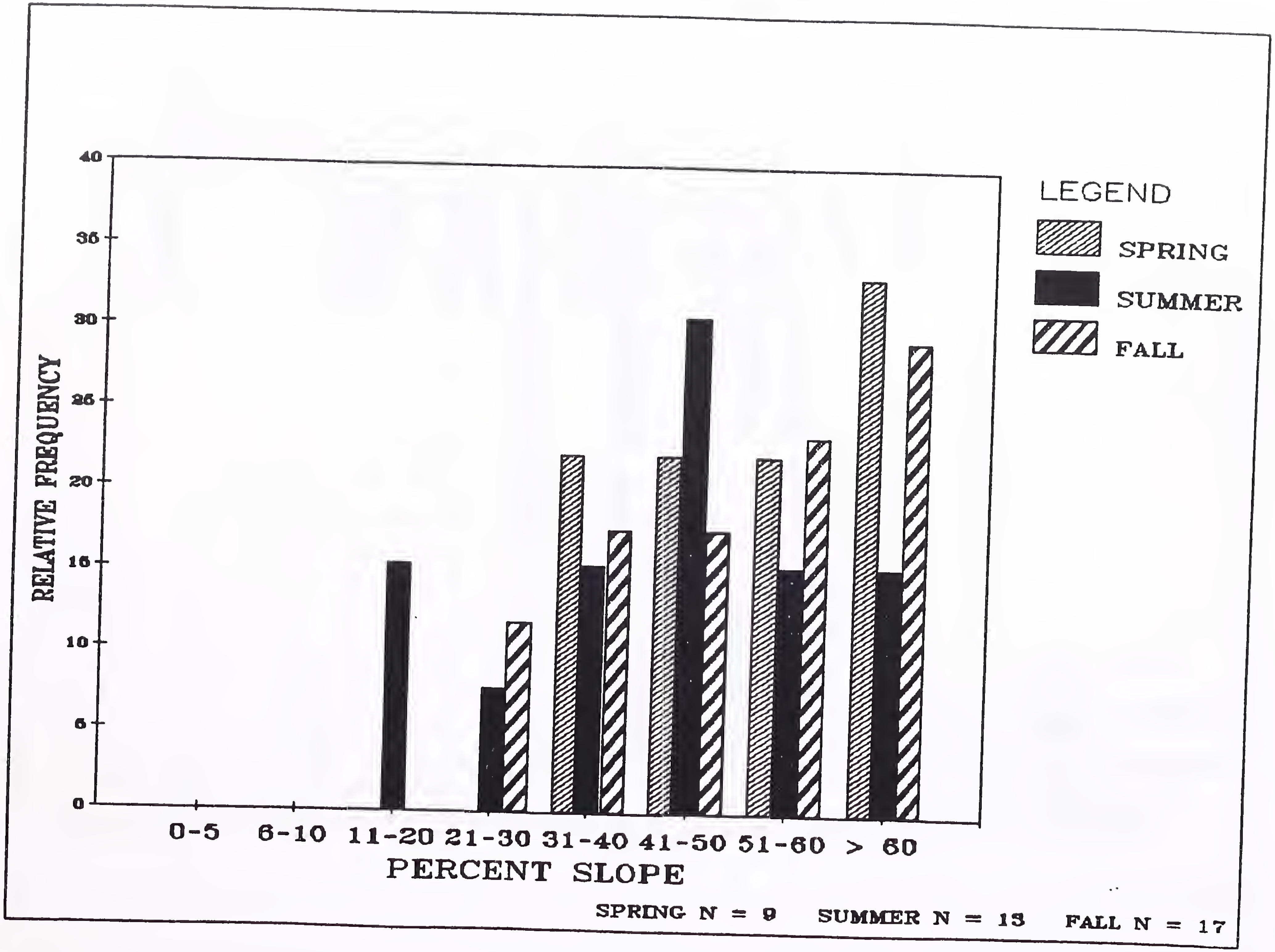


Figure 89. Grizzly bear use of snowchutes by slope.

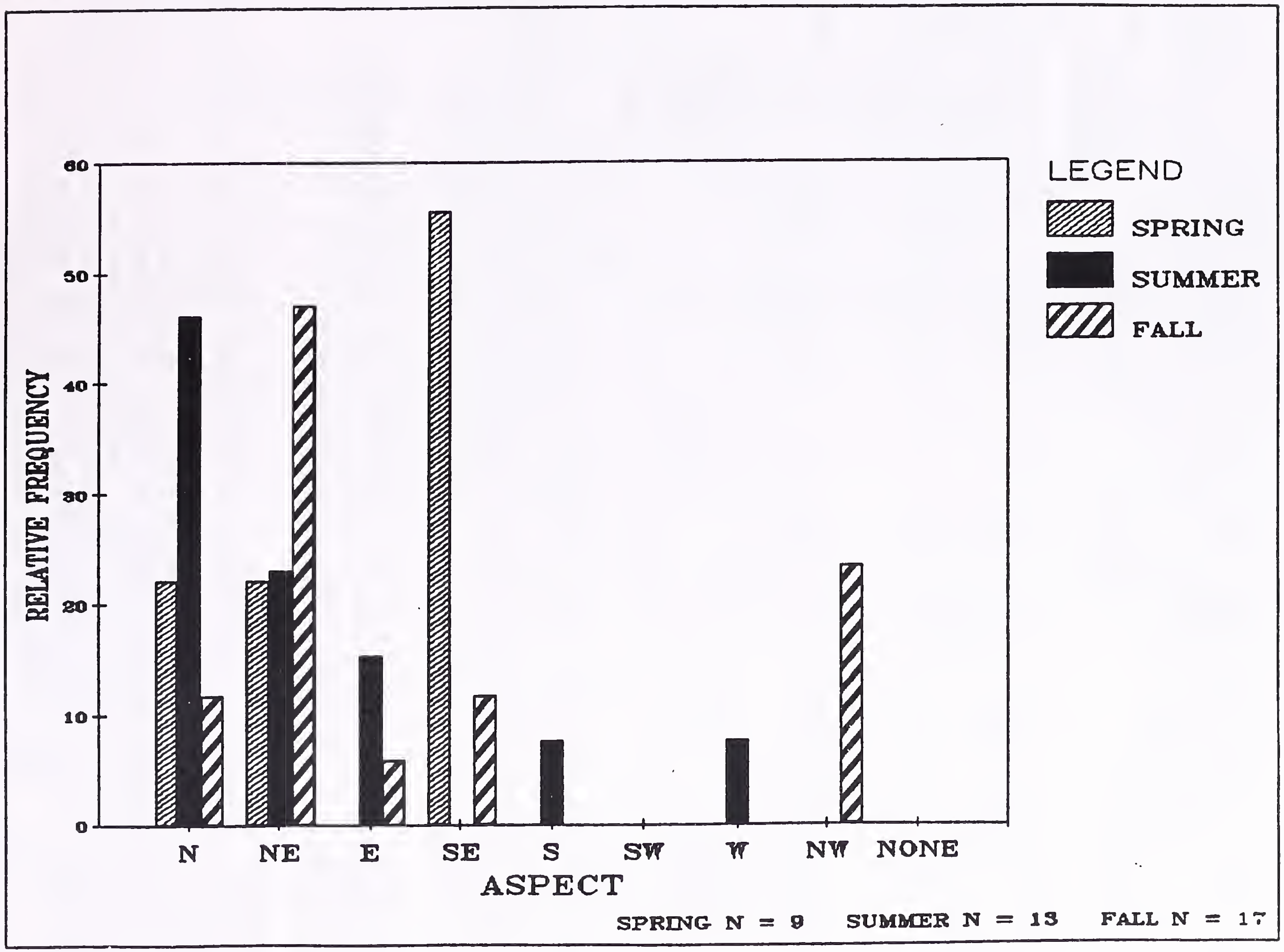


Figure 90. Grizzly bear use of snowchutes by aspect.

aspects. During the summer the aspects used shifted toward the cooler north facing slopes.

Table 60. Summary of data from vegetation plots (N=2) taken at radio locations of grizzly bears within the snowchute habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	0	0.0	0.0
> 10 cm. dbh	3	1.5	100.0
Shrubs			
Tall	1	0.3	50.0
Medium	3	7.5	100.0
Low shrubs/vines	1	0.3	50.0
Ferns and Allies	1	18.8	50.0
Graminoids	3	8.8	100.0
Forbs	28	50.0	100.0
Moss	-	0.0	0.0
Soil	-	7.5	50.0
Rock	-	8.8	100.0

Two feeding activities were observed within the snowchute component included grazing and digging roots. Roots dug included the roots of Hedysarum. Bears were observed bedding, traveling, and denning in this component. Considerable use of the snowchutes during the pre-denning and post-denning period was observed and often dens were located in or near snowchutes.

Snowchutes were used from den emergence until den entrance on the Rocky Mountain Front. The percent of radio locations within this component for spring, summer and fall were 23.1, 33.3, and 43.6 respectively.

Snowchutes on the east side of the Continental Divide often lack the lush vegetation described by Servheen (1981) for the Mission Mountains and by Zager (1980) for western Montana. Poor soil development and the predominantly limestone and dolomite sedimentary rocks which form the peaks and ridges do not provide the parent material for good vegetative growth. Progressing westerly in our study area the importance of snowchutes probably increases. This is clearly demonstrated in the Badger-Two Medicine area where the pacific maritime weather influences result in considerable snow accumulations and changing geology provides more lush growth and vegetative development in snowchutes. Examinations of these snowchutes indicates that they are often stable with an Alder over story and lush forb under stories with abundant bear foods. We have noted feeding on Heracleum and digging for Erythronium in these chutes during the spring and summer, however, our study terminated before we had an opportunity to work extensively within this region.

Sidehill Parks

Sidehill parks are timber enclosed, naturally open sites which occur on gentle to moderate slopes from mid to high elevations. Topo-edaphic conditions tend to keep these sites relatively dry. Tree cover is generally sparse and averaged 3.4% canopy coverage (Table 61). Detailed results of vegetation plots conducted within the sidehill park component are presented in Appendix F.

Table 61. Summary of data from vegetation plots (N=10) taken at radio locations of grizzly bears within the sidehill park habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	3	1.8	20.0
> 10 cm. dbh	6	2.2	70.0
Shrubs			
Tall	2	0.1	10.0
Medium	10	13.5	100.0
Low shrubs/vines	5	5.7	60.0
Ferns and allies	1	0.0	0.0
Graminoids	11	20.5	100.0
Forbs	74	24.2	100.0
Moss	-	0.1	10.0
Soil	-	15.1	100.0
Rock	-	4.2	90.0

The vegetation of sidehill parks was predominantly grasses and forbs. Exposed soil and rocks were prevalent at most sites. The grass species were predominantly dry site species such as Festuca and Agropyron. Common shrubs included Amelanchier, Juniperus, Potentilla, Rosa, and Shepherdia. Forbs that were dug for roots and corms included Hedysarum, Lomatium, and Allium.

Sidehill parks were classified into 13 different Pfister habitat types and 4 different Mueggler grassland habitat types (Table 62).

Habitat types within the Psme and lower Abla series comprised 64% of the use in the sidehill park habitat component.

Table 62. The frequency of habitat type series within the shrubfield component used by grizzly bears on the Rocky Mountain Front, 1977-87.

Habitat type series	Frequency			
	Spring	Summer	Fall	Total
Scree	0	0	0	0
PiFl	0	0	0	0
Psme	18	6	1	25
Picea	0	1	0	1
Lower Abla	15	7	1	23
Upper Abla/Pial	4	3	1	8
Pico	0	0	0	0
Grassland	4	5	0	9
Other	4	4	1	9

Sidehill parks used by bears ranged in elevation from 1328 to 2496 m. and averaged 1876 m.. Eighty four percent of the sites used were between 1500 and 2100 m. (Figure 91). Mean elevation between seasons was not significantly different.

Aspects of sidehill parks were frequently easterly to southerly (Figure 93). Sixty one percent of the sidehill parks used by bears were on aspects between 60 and 210 degrees.

The mean slope of sidehill parks was 31.3% and the range was between 5 and 80%. Most sidehill parks were between 10 and 50% slope (Figure 94). Mean slope for spring and summer was similar while in fall the slopes increased slightly. During the fall bears generally increased their use of high elevation sites with steeper slopes.

The principal feeding activities observed within the sidehill park component were grazing and digging roots (Table 63). Nonfeeding activities included some bedding and frequently travelling.

Bears were using the sidehill park component from den emergence until September (Figure 94). Most of the use was concentrated in the early spring and summer. Most of the spring activity involved grazing within this component with mixed root digging activity increasing as the seasons progressed. Forage within this component emerges early but also desiccates early because these sites are located on moderately steep slopes and warmer aspects.

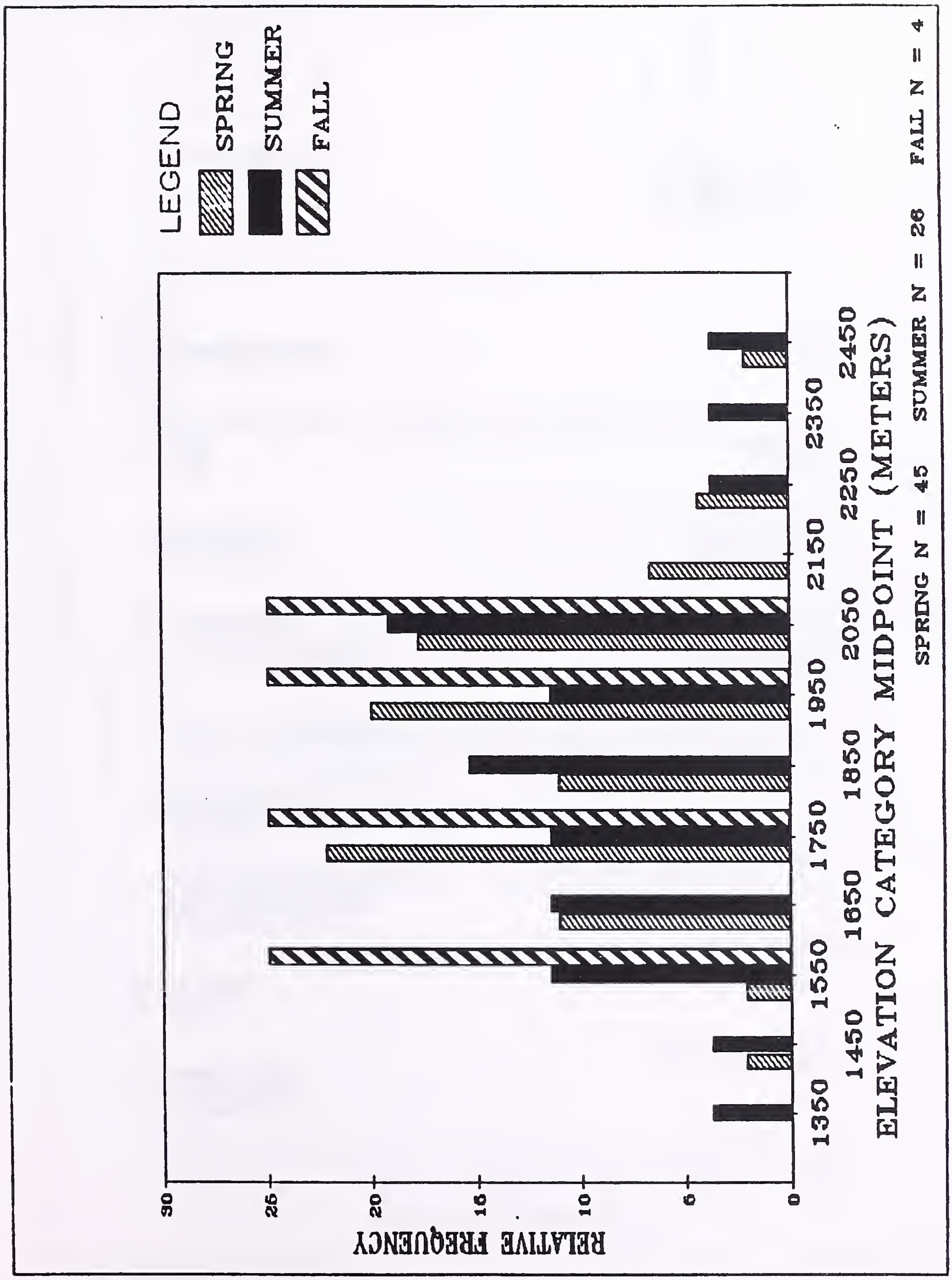


Figure 91. Grizzly bear use of sidehill parks by elevation.

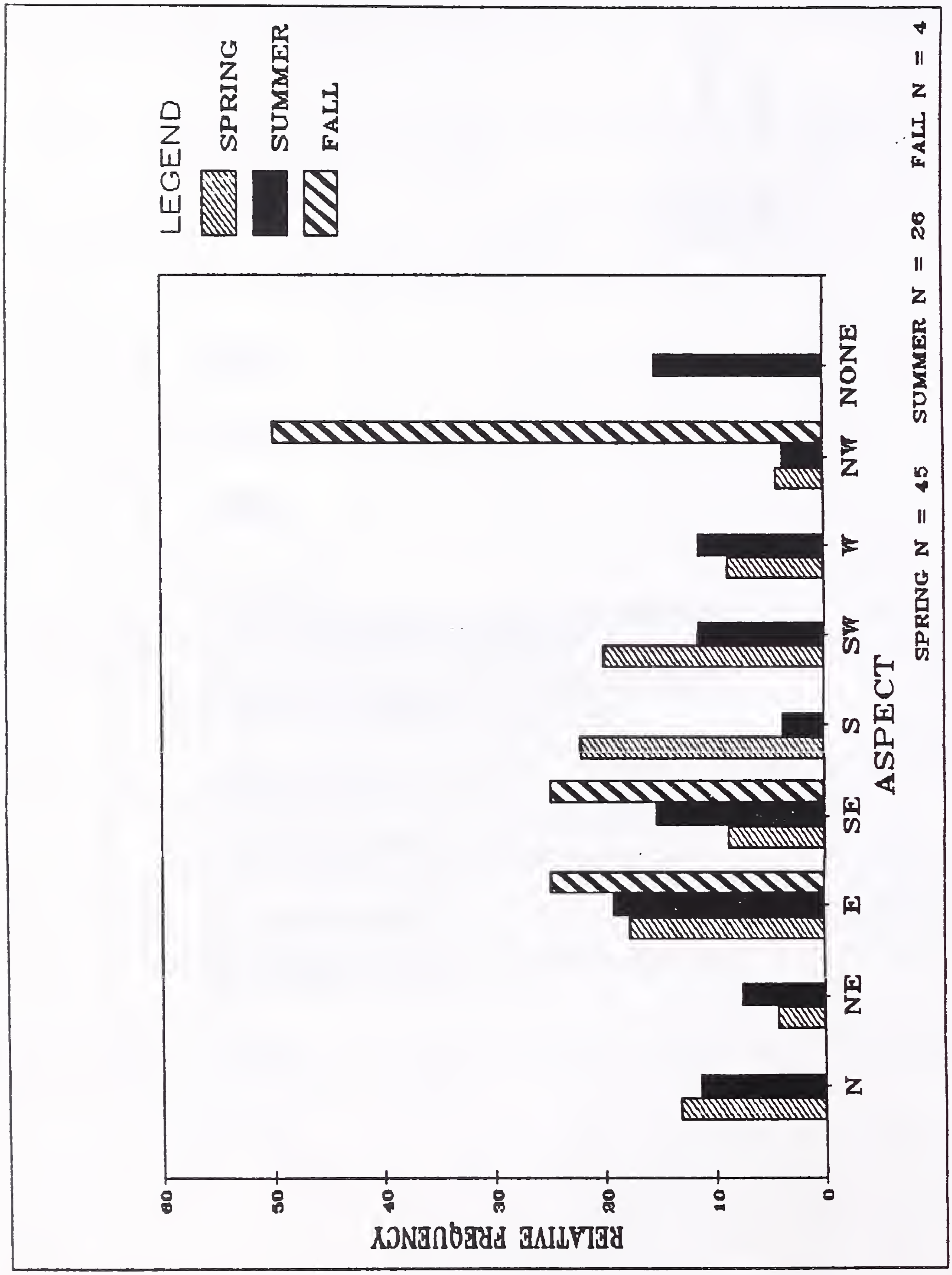


Figure 92. Grizzly bear use of sidehill parks by aspect.

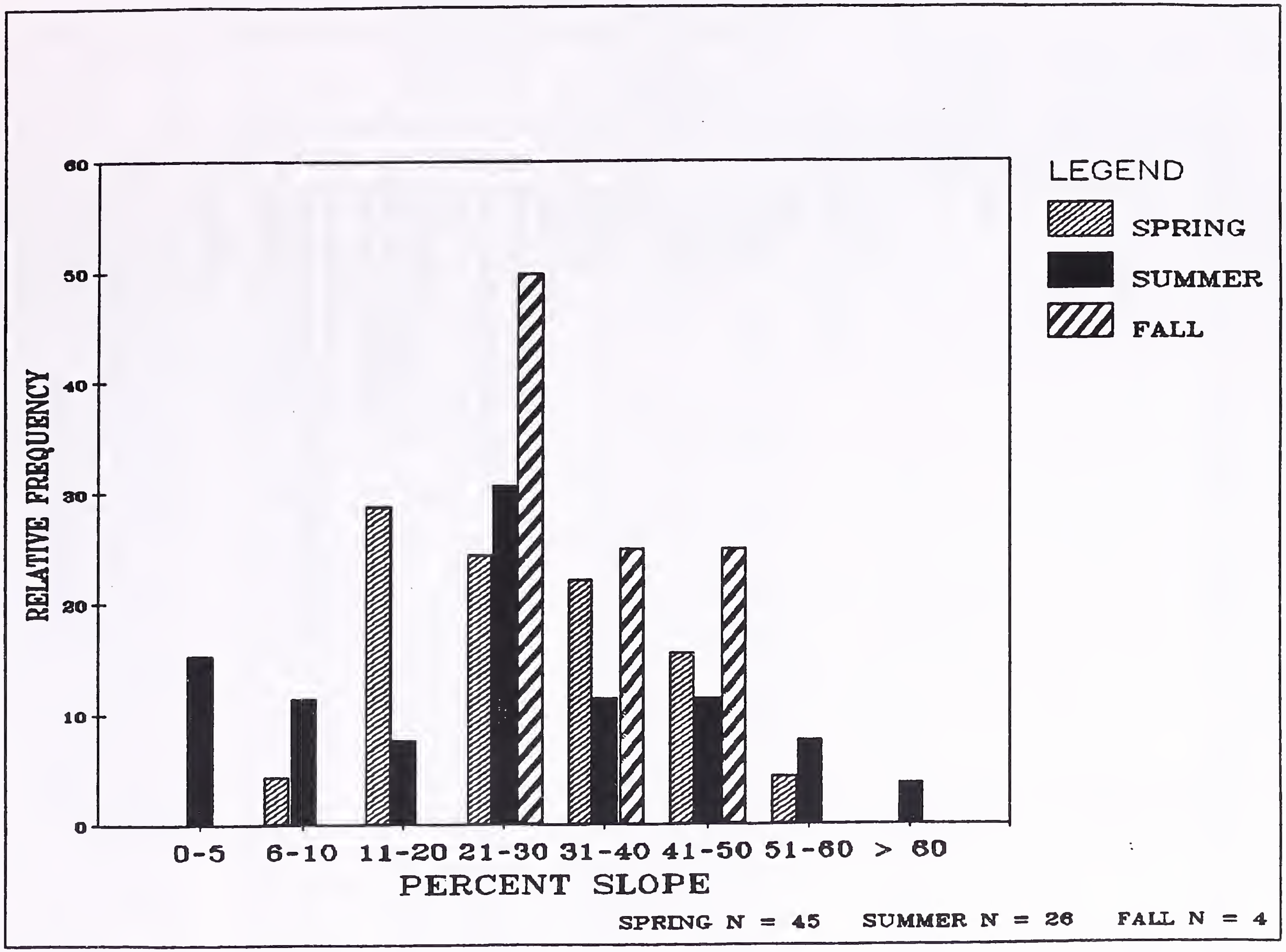


Figure 93. Grizzly bear use of sidehill parks by slope.

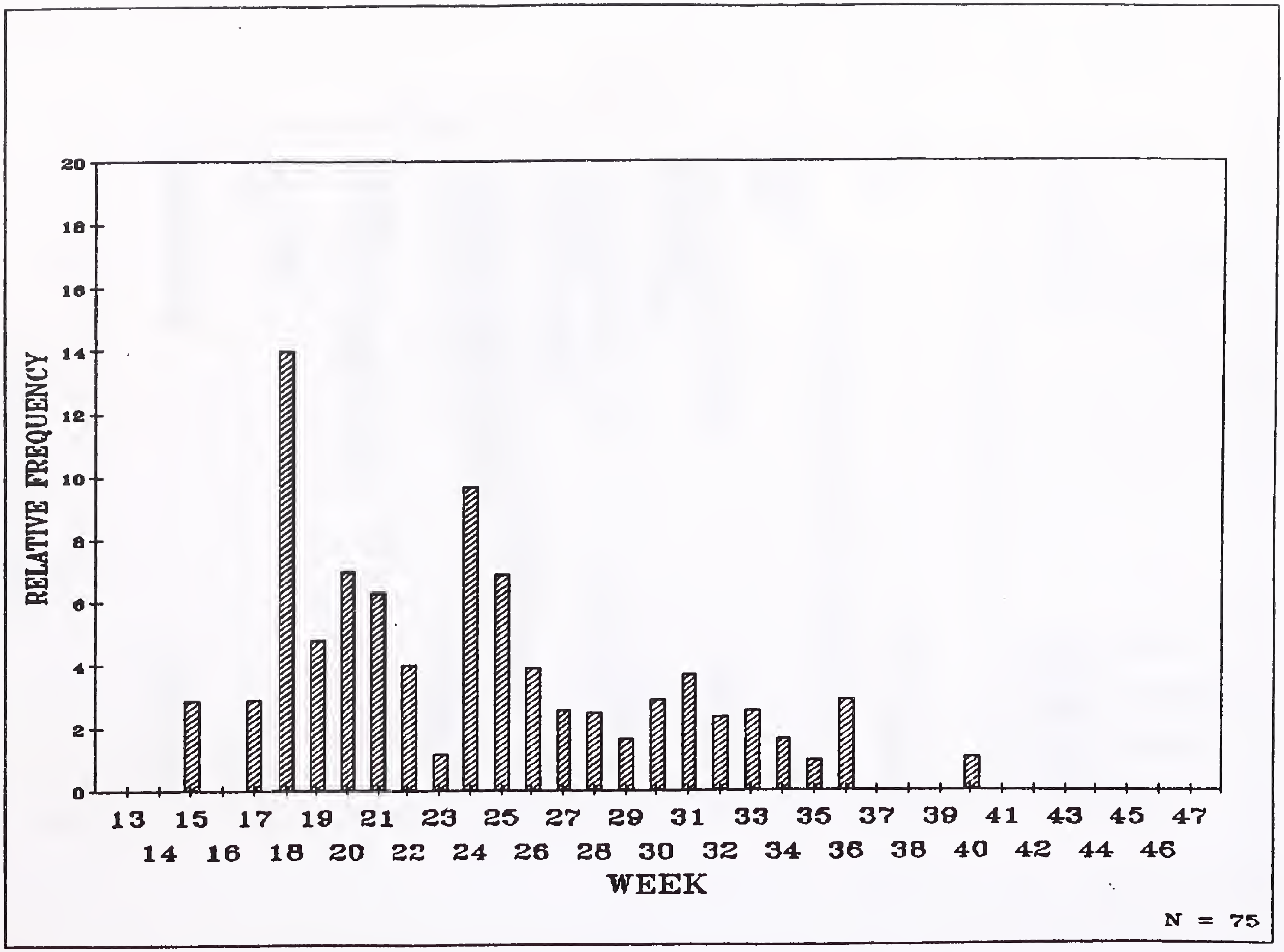


Figure 94. Grizzly bear use of sidehill parks by week.

Table 63. The frequency of grizzly bear activities observed within the sidehill park habitat component annually and seasonally, 1977-87.

Activity	Spring	Summer	Fall	Annual
Grazing	7	3	0	10
Digging roots	2	7	1	10
Digging small mammals	1	0	0	1
Insect feeding	0	1	0	1
Feeding on berries	0	3	1	4
Other feeding	0	1	0	1
Bedded	5	2	0	7
Travelling	6	4	0	10
Mating/courting	4	0	0	4

Prairie Grassland

Prairie grasslands are open sites dominated by extensive grass cover on varying aspects and lower slopes from low elevations up to 1829 m. (6000 ft.). Soil and moisture conditions varied from dry sandy soils to moist clays and loams. Mueggler's Stco/Bogr, Agsp/Bogr, Agsp/Agsm, Fesc/Agsp, and Pofr/Fesc types were predominant within this type. Farmland hay meadows and grainfields were included within this component. Detailed results from vegetation plots from the prairie grassland component are presented in Appendix F.

Vegetation was predominantly medium shrubs, grasses and forbs at sites used by grizzly bears in the prairie grassland component (Table 64). The shrub species frequently found were Potentilla, Artemisia, Juniperus, and Rosa. Common grasses within this component were Agropyron and Festuca. Forbs were dry site species such as Astragalus, Erigeron, Senecio, Sedum, and Lomatium.

Grizzly bear use of the prairie grassland ranged from 1207 to 1798 m. Ninety three percent of the observed use was in the elevational range from 1200 to 1600 m. Average slope of sites was 20.8% and ranged from 5 to 40%. Aspect of sites was not measurable as slopes were usually low.

Feeding on carrion and grazing were the two most frequently observed feeding activities within the prairie grasslands (Table 65). Most of the instances of grazing observed involved bears feeding in oat fields adjacent to riparian bottom lands. Bedding was observed in rare cases as bears fed on carcasses. Travelling was the most frequent non-feeding activity observed.

Table 64. Summary of data from vegetation plots (N=3) taken at radio locations of grizzly bears within the prairie grassland habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Shrubs			
Tall	0	0.0	0.0
Medium	3	10.2	100.0
Low shrubs/vines	2	1.0	66.6
Ferns and Allies	0	0.0	0.0
Graminoids	6	54.2	100.0
Forbs	31	22.5	100.0
Moss	-	0.0	0.0
Soil	-	12.7	66.6
Rock	-	12.7	66.6

Table 65. The frequency of grizzly bear activities observed within the sidehill park habitat component annually and seasonally, 1977-87.

Activity	Spring	Summer	Fall	Annual
Carrion	3	5	7	15
Grazing	4	0	1	5
Digging small mammals	2	0	0	2
Insect feeding	2	1	0	3
Bedded	2	0	0	2
Traveling	14	7	4	25
Mating/courting	1	0	0	1
Other non-feeding	0	1	0	1

Grizzly bears used the prairie grassland component from den emergence until den entrance (Figure 95). Use during spring comprised 51.9% of the total use observed in this component. During the spring bears were observed traveling across these plains between important feeding habitats along the riparian zones.

Mountain Grassland

Mountain grasslands are open sites dominated by extensive grass cover on varying aspects and slopes, from intermountain valley bottoms to upper slopes and benches above 1828 m. (6000 ft) along the Rocky Mountain Front. Moisture conditions vary but these grasslands are slightly more mesic than the prairie grasslands due

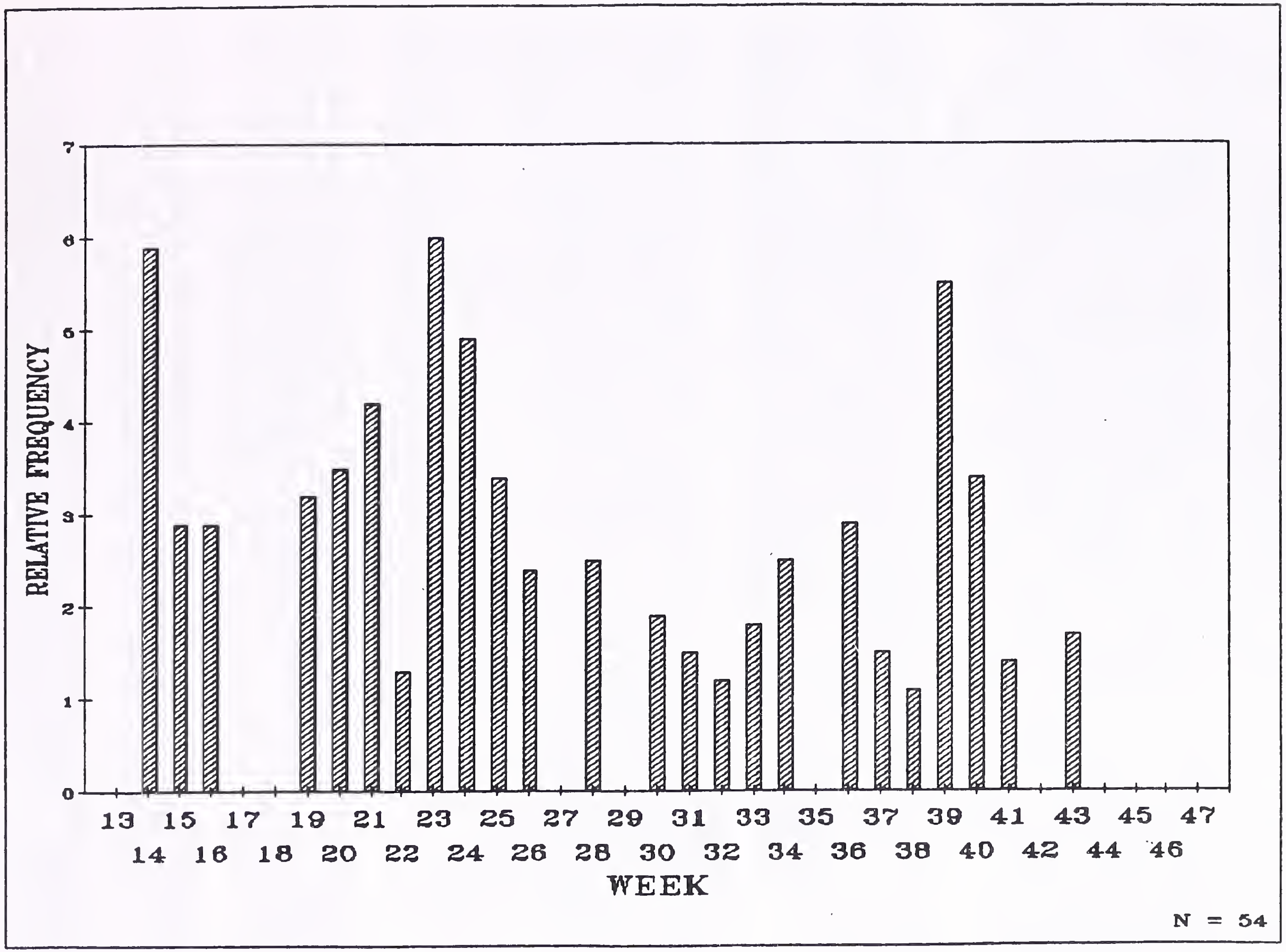


Figure 95. Grizzly bear use of prairie grassland by week.

to their elevation and location within the mountainous portions of the study area. Muegglers Fesc/Feid, Fesc/Agsp, and Fesc/Deca habitat types are readily found in this component. Results from vegetation plots from this component are presented in Appendix F.

In this component, grasses and forbs were co-dominant (Table 66). Although sample size is small, there appeared to be a higher forb composition in mountain grasslands as opposed to prairie grasslands. Potentilla was the common shrub observed. Although not recorded in the vegetation plots common shrubs also include Shepherdia, Amalanchier, and Juniperus none of which are found in great abundance on these sites. Forbs included Lupinus, Lomatium, Penstemon, Senecio, Sedum, and Taraxacum. Hedysarum and Lomatium were two forbs identified in this component not in our sample plots. Both species are dug by bears for their roots.

Table 66. Summary of data from vegetation plots (N=2) taken at radio locations of grizzly bears within the mountain grassland habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Shrubs			
Tall	0	0.0	0.0
Medium	1	7.5	50.0
Low shrubs/vines	0	0.0	0.0
Ferns and Allies	0	0.0	0.0
Graminoids	4	38.8	100.0
Forbs	22	38.8	100.0
Moss	-	0.0	0.0
Soil	-	19.0	100.0
Rock	-	0.0	0.0

Mountain grasslands used by bears ranged between 1469 and 2207 m. in elevation. The mean elevation was 1870 m. There was observed use of this component during the spring and summer. Mean elevation during the spring was slightly lower (1839 m.) than the mean for the summer (1897 m.).

Most of the use (86.6%) was on warm aspects ranging from 60 to 270 degrees from north. Slopes were gentle, averaging only 20.8% with no difference in mean slope for seasons.

Feeding activities observed included root digging and feeding on berries. Traveling and mating/courting were nonfeeding activities observed. It is likely that some grazing does occur within this component but its generally dry nature suggest that it is infrequent and in our small sample size we did not detect it.

Use of the mountain grassland component was detected in only 15 instances between May and August (Figure 96). It would be during this spring and summer window that forage values of the grass/forb cover would be highest and fruit production available on the shrub species. Due to the open nature of this habitat component and lack of critical food resources, this component may not be of high value to bears directly. However, many of these extensive grassland areas are within critical winter range of elk, deer, and sheep and may provide carrion during certain seasons and may have higher indirect value to grizzly bears.

Meadows

Meadows are naturally open, level, slightly concave (wet) or convex (dry) sites of variable size and shape. They occur from low elevations and bottoms to high elevation benches. Trees and shrubs are notably lacking within meadows, but generally border and enclose the meadows. Meadows were generally not larger than five acres in size. Details from vegetation plots recorded within the meadow component are presented in Appendix F.

Vegetative cover in the meadow component was principally grass and forb (Table 67). Few trees and medium height shrubs were present. Tall shrubs included Salix while the medium shrubs were commonly Potentilla, Ribes, Rosa, Shepherdia, and Symphoricarpos. Common grasses included Poa, Phleum, Bromus, and Carex. Forbs within the component were a mixture of dry and wet site species including Cirsium, Taraxacum, Cruciferae, Heracleum, Fragaria, Potentilla, and Senecio.

Most (66.6%) of the meadows used by bears were on slopes less than 10% and therefore aspect had little significance. Those with discernable aspects were mostly (33.4%) on cool northerly and easterly aspects. The average slope of sites was 10.9%.

The feeding activities recorded within this component included feeding on carrion, grazing, and feeding on berries. One third of the records were of grazing, indicating the importance of the grass and forb foods within this component. Non-feeding activities included traveling and mating/courting.

Grizzly bears were recorded using this component principally during the forage season from April until September (Figure 97). The spring period accounted for 66.7% of the observed use.

Only 15 radio locations were recorded within this component during the study, however, we feel that it was an important component for grazing particularly on the grass/carex vegetation. The infrequent occurrence and small size of this component may result in a

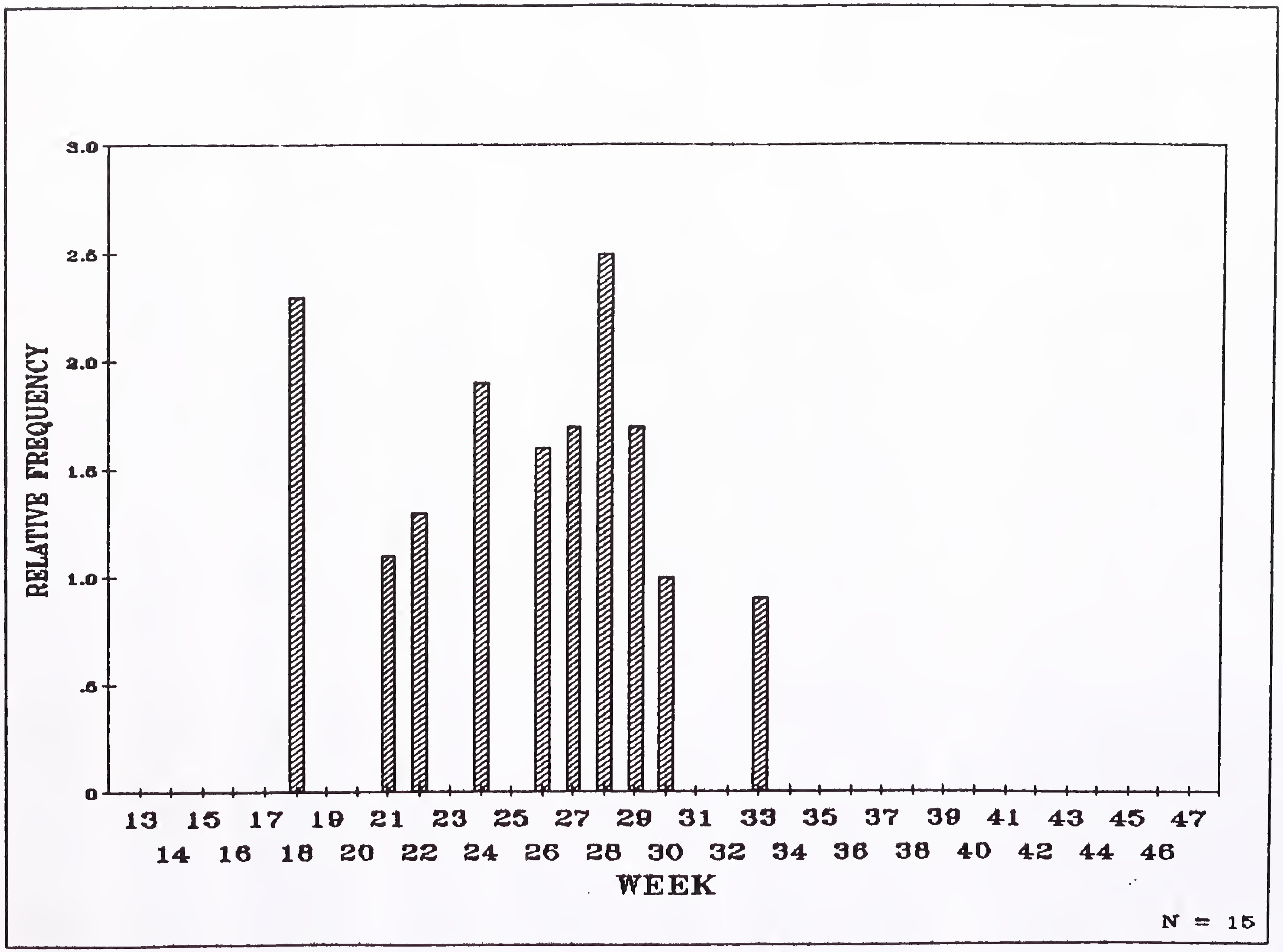


Figure 96. Grizzly bear use of mountain grassland by week.

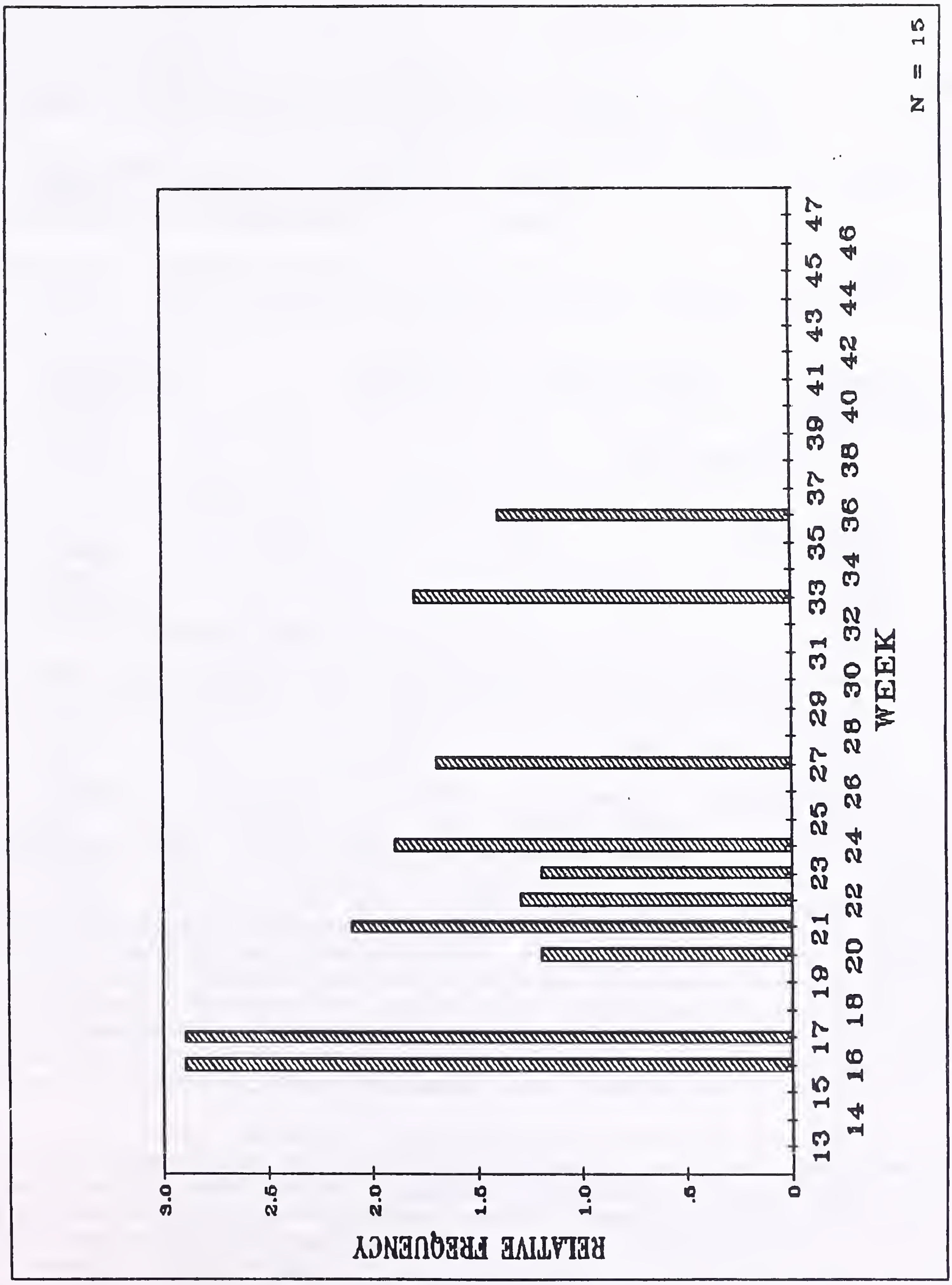


Figure 97. Grizzly bear use of meadows by week.

sampling bias when using radio telemetry to sample habitat use. Radio location error and avoidance behavior by bears to our radio tracking efforts could have resulted in underestimating the use of this small, open component.

Table 67. Summary of data from vegetation plots (N=5) taken at radio locations of grizzly bears within the meadow habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	3	3.5	40.0
> 10 cm. dbh	3	3.6	60.0
Shrubs			
Tall	1	0.1	20.0
Medium	7	4.5	80.0
Low shrubs/vines	1	0.1	20.0
Ferns and allies	0	0.0	0.0
Graminoids	10	52.5	100.0
Forbs	41	31.5	100.0
Moss	-	0.0	0.0
Soil	-	0.9	100.0
Rock	-	0.5	60.0

Rock/Talus/Scree

This component represents flat to steeply sloped sites predominantly covered with rocks of varying size, shape and composition. Rock/talus/scree sites occur from lowlands to alpine, however, the predominant occurrence is above timberline to the peaks and ridges throughout the study area. This broad component is composed of glacially scoured slabrock, bedrock cliffs, unstable slide areas, and flood scoured rubble. Vegetation is sparse and usually consists of low mat forming forbs and shrubs or sparse bunchgrasses. Occassional trees take root usually in wind stunted form. Ecologically, the vegetation of these sites can be considered topo-edaphic climaxes. Detailed results from vegetation plots within this component are presented in Appendix F.

Trees comprised less than 2% of the average canopy coverage within this component (Table 68). Subalpine fir and Pinus albicaulus were the two coniferous tree species present. Rock and soil comprised 76.5% of the ground cover. Occassional shrubs with a sparse grass/forb understory characterized the vegetation. Common shrubs were Alder, Rosa, Potentilla, Artemesia, and Dryas. Grasses were mostly Agropyron and Festuca. Common forbs were dry site species such as Antennaria, Aster, Arenaria, Astragalus, Erigeron, Lupinus, Sedum, Hedyasarum, and Lomatium. Occasionally a wet seep area within a rock complex would shelter species such as Equisetum, Carex, and Poa. Species known to be dug for their root or tubers in this component were Hedysarum, Claytonia megarhiza, Lomatium, Allium and Cardamine rupicola.

Table 68. Summary of data from vegetation plots (N=27) taken at radio locations of grizzly bears within the rock/talus/scree habitat component, 1978-87.

Vegetation class	Number of species	Mean canopy coverage	Percent frequency
Trees			
< 10 cm. dbh	4	0.9	22.2
> 10 cm. dbh	5	0.9	29.6
Shrubs			
Tall	2	1.5	3.7
Medium	9	1.7	44.4
Low shrubs/vines	4	0.2	25.9
Ferns and Allies	1	0.6	3.7
Graminoids	22	5.0	92.6
Forbs	90	15.9	100.0
Moss	-	0.7	18.5
Soil	-	34.6	100.0
Rock	-	37.2	96.3

This component was further classified into Pial/Abla habitats near timberline, a scree classification commonly defined for sites at lower elevations, and an alpine scree defined as scree above the timberline. Of the 178 radio locations classified within the rock/talus/scree component 90.5% were within the alpine scree classification, 2.8% were in timberline forested habitat types, while 6.7% were in sites at lower elevation scree sites.

Rock/talus/scree components used by bears ranged from 1395 to 2829 m. and averaged 2416 m. Sites above 2000 m. comprised 97.6% of the locations within the rock/talus/scree component (Figure 98). Mean elevation for spring and fall were similar while the mean elevation increased during the summer period.

Slopes averaged 52.4% for rock/talus/scree sites used by grizzlies. Most (81.6%) of the slopes were greater than 30% slope and commonly 50-60% (Figure 99). Mean slope was significantly lower during the spring season but similar during the summer and fall.

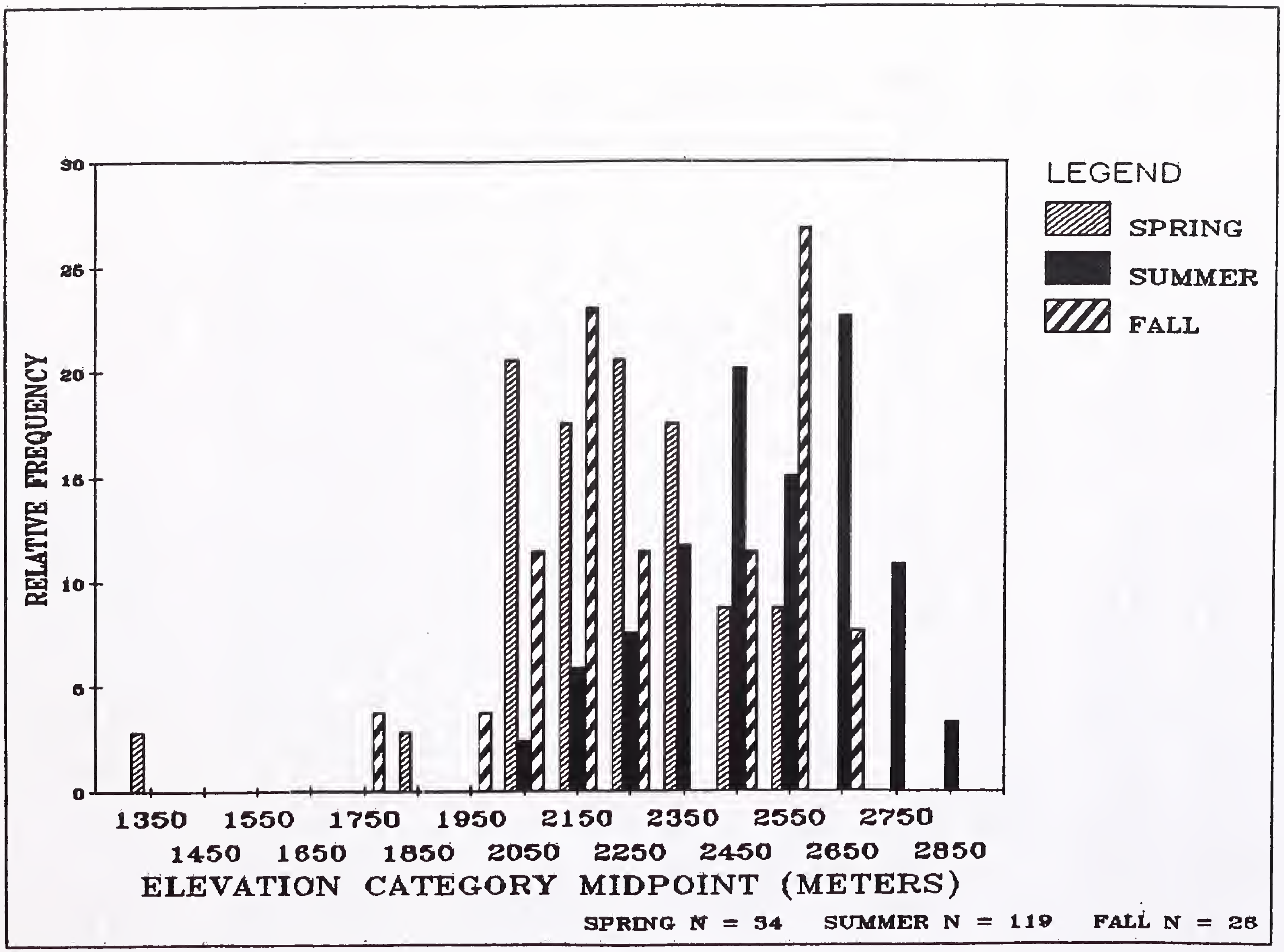


Figure 98. Grizzly bear use of rock by elevation.

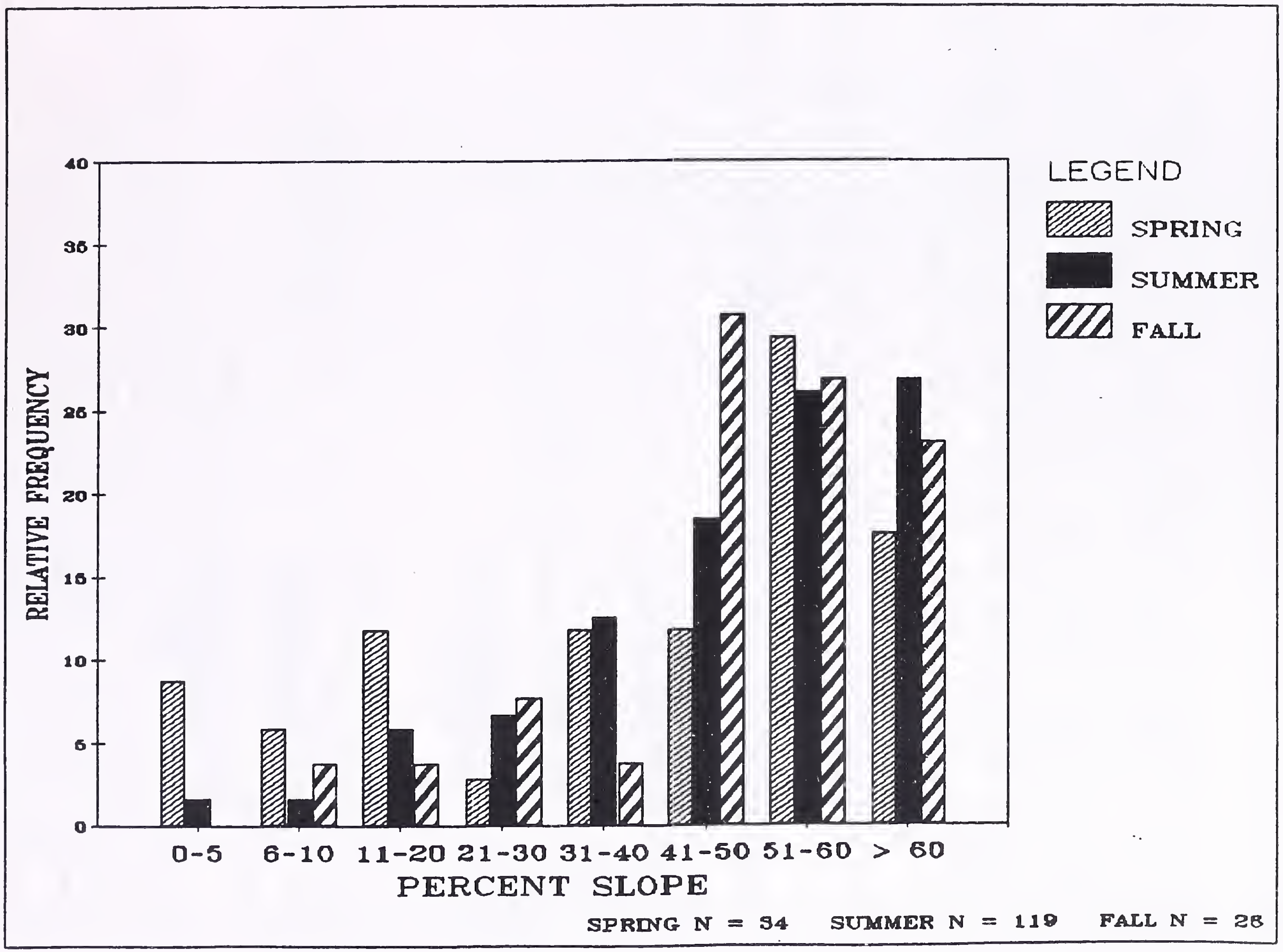


Figure 99. Grizzly bear use of rock by slope.

Aspects were variable and use occurred in all aspect categories (Figure 100). A slight shift from easterly aspects to westerly aspects was noted from spring to summer. Aspects used during the summer and fall were largely southerly and westerly.

Important feeding activities observed within the rock/talus/scree habitat component were digging roots and digging small mammals (Table 69). Small mammals dug included picas, marmots, and ground squirrels. We did observe an insect feeding concentration on Red Mountain off the west edge of our study area, which appeared to be of cutworm moth larvae that bears were finding on very steep westerly slopes. Bedding and traveling were notable non-feeding activities observed. We did find beds scraped in open talus slopes with bear scats and digs surrounding them and observed bears laying in beds in these remote sites. Many beds were also just at timberline or near den sites within this component.

Table 69. The frequency of grizzly bear activities observed within the rock/talus/scree habitat component annually and seasonally, 1977-87.

Activity	Spring	Summer	Fall	Annual
Carrion	1	0	0	1
Digging roots	8	64	15	87
Digging small mammals	0	24	1	25
Insect feeding	0	1	0	1
General feeding	0	2	0	2
Bedded	4	5	0	9
Traveling	8	13	5	26
Mating/courting	6	0	0	0
Denning	2	0	2	4

The rock/talus/scree component was primarily utilized by bears from May until September (Figure 101). We observed some use of this component in all seasons. Most of the use, however, was during the July-August period when root digging activities were pronounced.

The rock/talus/scree component, particularly the alpine scree habitats, have a surprisingly high value to grizzly bears on the Rocky Mountain Front. We detected several important concentration of bears digging for roots, small mammals, and insects within or near our study area. Peaks such as Rocky Mountain, Baldy Mountain, Scapegoat Plateau, and Red Mountain receive considerable summer use. The use was observed even in the steepest and roughest shale and rock terrain. Of particular significance was the number of productive aged females with families that were observed using

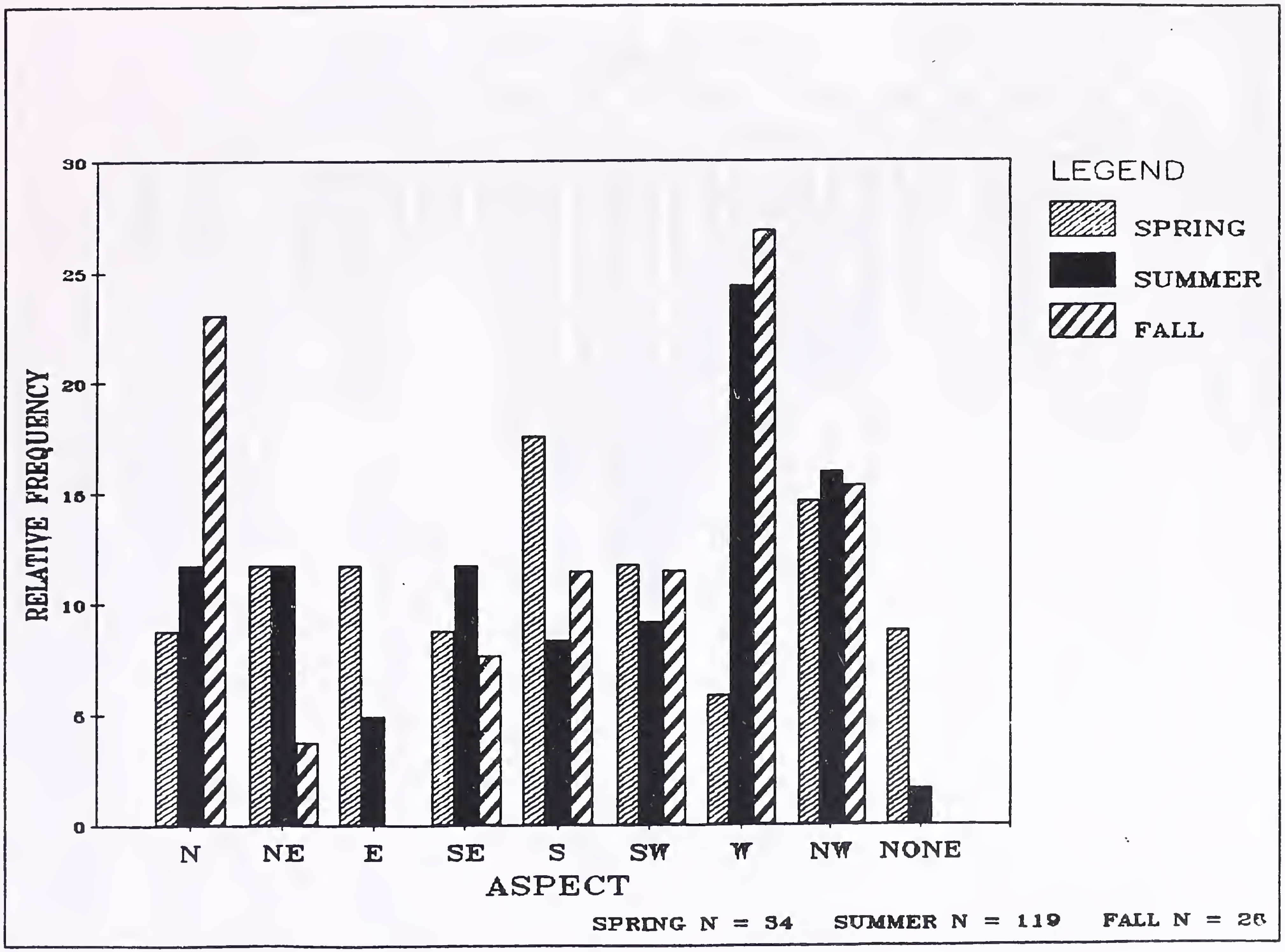


Figure 100. Grizzly bear use of rock by aspect.

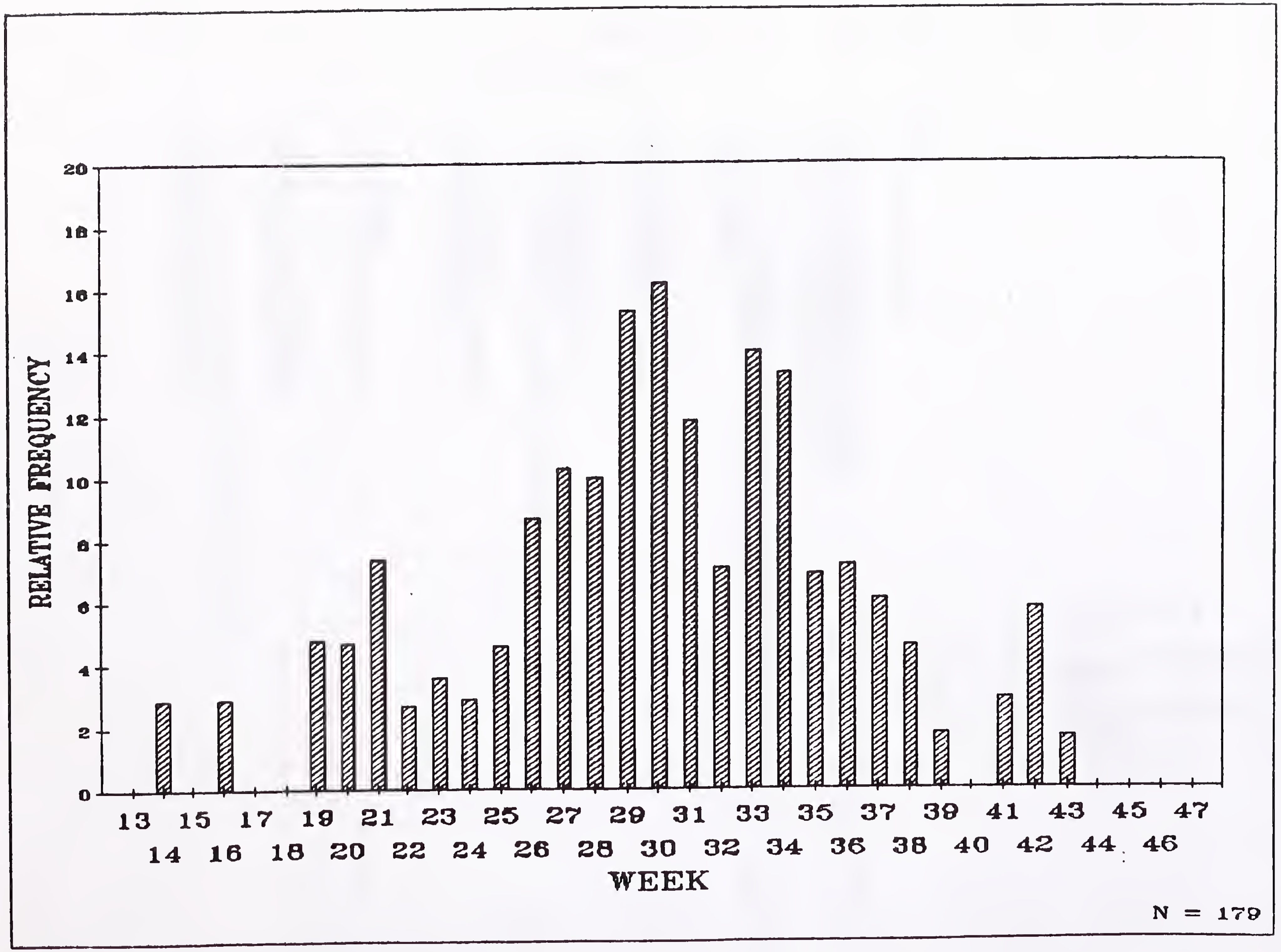


Figure 101. Grizzly bear use of rock by week.

these remote and secure habitats. In some cases we could see as many as 10 different grizzlies on one mountain peak including in one instance two family groups (two females with five cubs) within 50 m. of each other.

Population Biology

Specific long term population data were obtained from the core of the study area between Deep Creek and Birch Creek. Additional population data were obtained from the adjacent areas north and south, however, it lacked the long term integrity and depth that the data from the core area provided. Discussion of population trend is primarily confined to this core area. Minimum counts, sex ratio data, age distribution, mortality data, reproduction data and density estimates were derived using data from the entire east front study area.

Sex ratios and age distribution

No single year provided sufficient numbers of marked bears to derive a representative age distribution for the population. An age distribution of the pooled sample of capture data from 1977-87 was derived (Figure 102). The distribution of captures may not resemble that of the population, however, some simple observations were made.

Ages of bears at the time of capture ranged from cubs to 21 years of age. The oldest bear reported was a female (220) who attained an age of 25 when last observed. The oldest age attained by a male grizzly (332) was 16. Few male bears survived beyond age 10 while several females survived well into the teens. Cubs were rarely captured and are under represented as an age group in the capture data.

The marked and unmarked bears observed in the core area from 1980-86 were classified by age (Table 70). The proportion of adults and subadults over the course of the study remained somewhat stable, however the proportion of cubs and yearlings alternately fluctuated by as much as five-fold.

The number of cubs observed one year and yearlings observed the next year was relatively consistent implying that the same bears were likely being censused during the observation period. There were some years in which the yearlings observed did not correlate exactly with the cubs produced the previous year indicating that some bears were not observed each year.

The sex ratio of all first time captures including management bears was 63.3% males and 36.7% females. The actual sex ratio of research first time captures was 55% males and 45% females. The sex ratio of all cubs and yearling first time captures (N=8) was 50% males and 50% females. The sex ratios of all subadult (N=19)

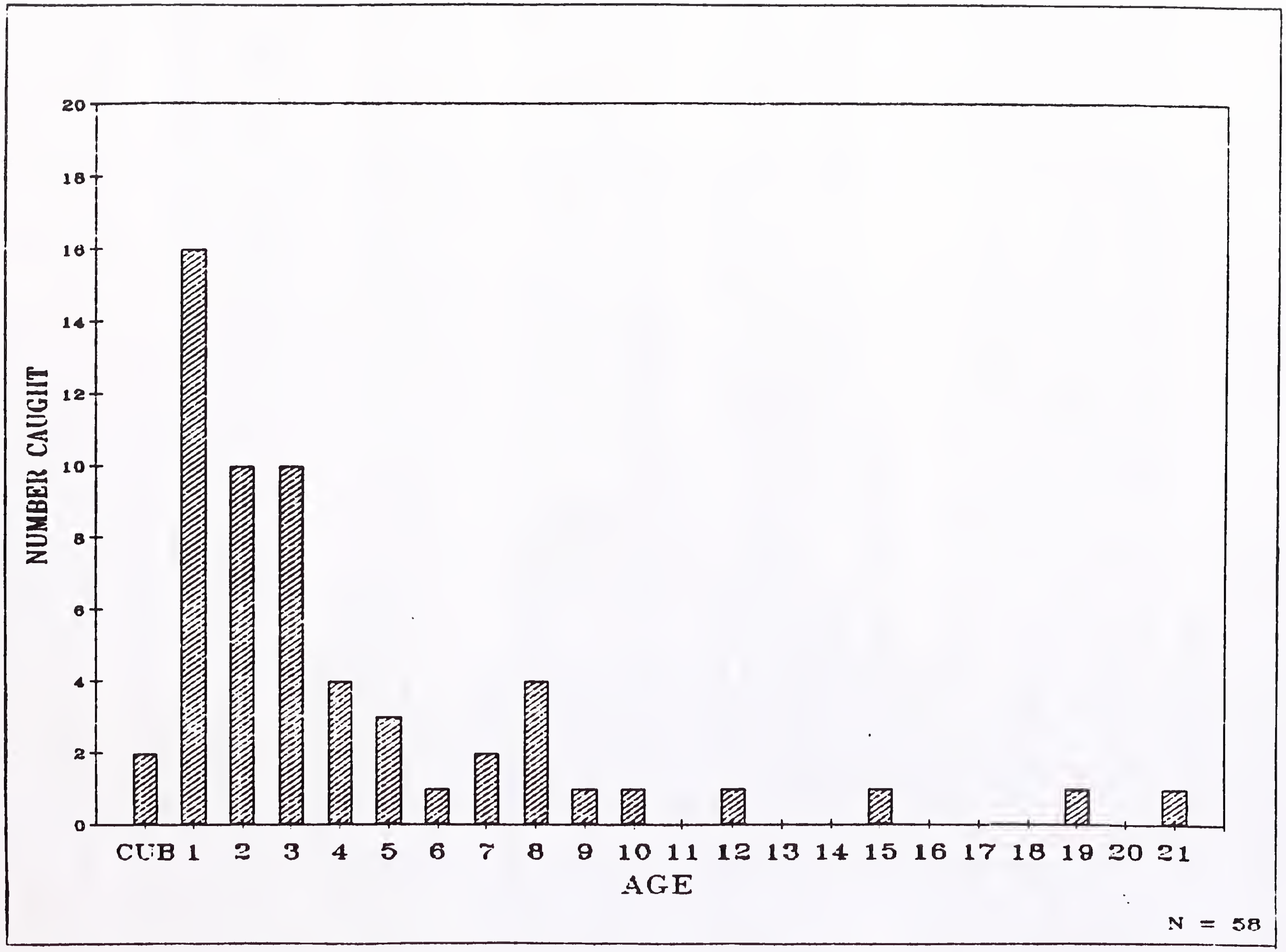


Figure 102. Age of grizzly bears at first capture.

and adult (N=13) first time captures was 58% M/42% F and 54% M/46% F respectively.

Table 70. Age structure recorded for the Deep Creek to Birch Creek area, 1980-86.

Year	Number of adults	Number of subadults	Number of yearlings	Number of cubs
1980	8	6	6	7
1981	9	8	7	2
1982	9	11	2	11
1983	11	4	8	3
1984	11	7	3	12
1985*	9	7	15	5
1986	8	7	5	6
Avg.	9.3	7.0	6.6	6.6
Avg. %	31.5	23.7	22.4	22.4

* The 1985 data was updated based on observations in 1986 of two adult females with five yearling cubs on Rocky Mountain which were apparently not observed in 1985. One of these was a female with a collar which no longer functioned. Since there were no observations of cubs in 1985 both adults and five cubs were added into the 1985 totals.

Population Productivity

Productivity parameters examined included age of first reproduction, litter size, total cub production and breeding interval. Age of first reproduction and breeding interval were determined from marked bears. Litter size and cub production were examined from a data set including marked and unmarked bears sighted during the study.

Litter size was determined from the records of marked bears and direct sightings of females with cubs (Table 71). The records at the beginning and end of the study were lowest. This could be a function of the number of radioed bears used in the sighting records. Sightings in the field without the aid of a radio-collar and multiple records could underestimate litter size because not all cubs may be seen in a single encounter. All of the sightings in 1976 and 84% of the sightings in 1987 were of unmarked bears generally seen only once. Sightings from 1977-1986 were mostly from marked bears observed several times during the year.

Table 71. The number of females with cub litters sighted on the Rocky Mountain Front, 1976-87.

Year	Number of females	Number of cubs	Average litter
1976	3	5	1.67
1977	2	5	2.50
1978	4	9	2.25
1979	1	2	2.00
1980	4	9	2.25
1981	1	2	2.00
1982	4	11	2.75
1983	3	6	2.00
1984*	8	18	2.25
1985*	2	5	2.50
1986	3	8	2.67
1987	6	9	1.50
Total	41	89	2.20

* Adjustments were made to include knowledge of litters for marked bears identified the next year with litters of yearlings.

Eighty-nine cubs were accounted in 41 litters from 1976-87 for a mean litter size of 2.20. Craighead et al (1974) reported a mean litter size of 2.24 in Yellowstone National Park while Knight and Eberhardt (1985) report an average litter size of 1.9 in the same area but a different time period. Elsewhere in Montana, litter sizes ranged from 2.12 in the Mission Mountains to 2.66 along the Flathead River (Dood et al 1986).

South of the Sun River females with cubs have been sighted (N=4) in only three of the last eight years of the study. Average litter size from sightings from this area was only 1.5. Only one productive female was captured and contributed to the data base. This female (301) produced a litter of two cubs in 1988 which is not included in the table.

Female with cub observations during 1980-87 from north of the Sun River (N=27) comprise 87% of the total female with cubs observations. Average litter size for this area during 1980-87 was 2.3. Much of the data were derived from productive marked female bears monitored over several years.

The lower production noted south of the Sun River correlates well with the data on bear density and capture rate. All indications were that the population demographics of the grizzlies from this region varied from that of the northern half of the study area.

The average yearling litter size recorded in observations from 1976-87 was 2.18 (Table 72). This was not significantly lower than the average litter size for cubs (P<0.05). The yearlings recorded from each year (1981-87), when projected back one year, account for 96.6% of the cubs reported each year 1980-86. This suggested that many of the cubs observed one year were probably observed again the following year. Prior to 1980, records were less consistent and suggested fewer cubs were observed in one year (70% of the yearling population the next year) than yearlings the following year. This is likely due to the limited radio marking which had taken place on productive adult female grizzlies.

Table 72. The number of females with yearling cubs sighted in the entire east front area, 1976-87.

Year	Number of females	Number of cubs	Average litter
1976	8	16	2.00
1977	6	11	1.83
1978	4	8	2.00
1979	3	6	2.00
1980	2	5	2.50
1981	4	9	2.25
1982	1	2	2.00
1983	5	11	2.20
1984	2	5	2.50
1985	9	18	2.00
1986	2	5	2.50
1987	3	7	2.33
Total	49	103	2.18

Using the records of marked bears and their litters, sightings and track records from a file of unduplicated female with cub observations we were able to calculate annual minimum numbers of cubs produced for the Rocky Mountain Front (Figure 103). Because data included track records and sightings it is likely that more cubs existed in at least some litters than was reported. Occasionally a record of female and cub tracks was collected in which the exact number of cubs could not be discerned. In these cases, the sighting of tracks was assigned only one cub. In addition it was assumed that we did not observe all litters within the study area in any one year.

During the period 1976-87, 124 cubs were produced for an average of 10.3 (S.D.=2.46, 95% C.I.=8.77-11.90) cubs per year. The regression for the data was increasing, but the slope was not

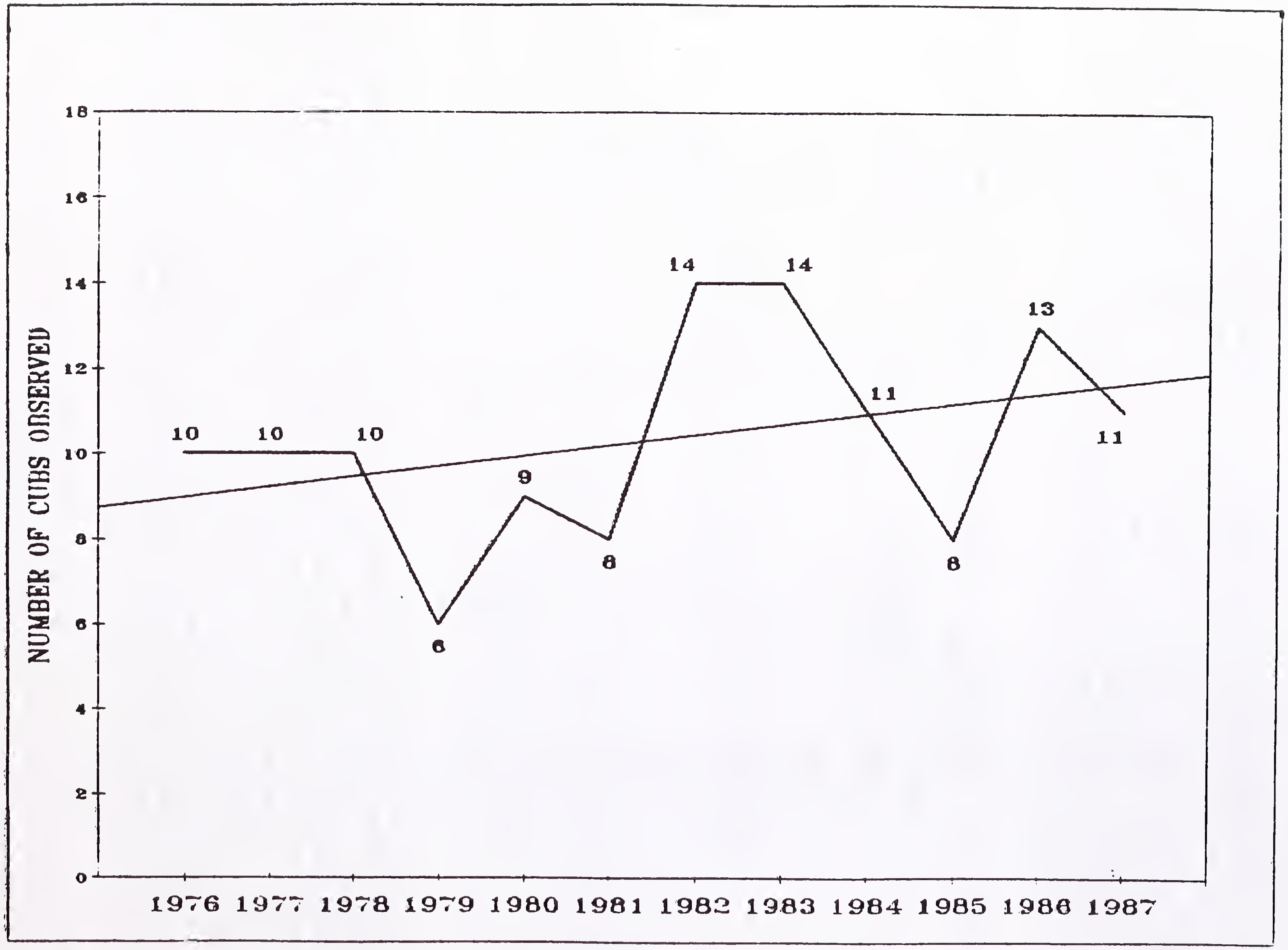


Figure 103. Observed cub production.

statistically significant (P=.25). The minimum number of cubs produced annually ranged from 6 to 14.

Age of first reproduction was determined for four grizzly bears marked during the study. The average age of first reproduction was 6.5 and ranged from 4.5 to 7.5. McClellan (1982) reported females producing their first litters at age 5.5 in B.C., Canada. Craighead et al (1974) found 4.5 to be the youngest age of first successful conception. In the Yukon, 6.5 years was the youngest age of first reproduction (Pearson, 1985).

Two of the litters produced by first time mothers were lost early in the spring. In one case a litter of three was observed with the mother until May, then was not observed again. The second case involved a female captured with signs of lactation but no evidence of cubs. It was assumed that she lost her cubs shortly after den emergence.

Several bears were observed engaging in breeding activity several years before finally producing the first litter. Bear 335 was bred in 1982 at age 4.5 and failed to produce cubs in 1983. Bear 366 was pairing with males beginning in 1984 at age 5.5 and again in 1985 and 1986, before finally producing a litter which she lost in the spring of 1987. She has not successfully raised a litter of cubs as of 1988 when she attained an age of 9.5. There was evidence of a litter produced by her in 1986 but she may have lost the entire litter then as well. We have noted breeding behavior in other subadult females which had not produced litters at the completion of the study. Craighead et al (1969) suggests the presence of false estrous in subadult female bears in Yellowstone National Park.

Eleven breeding intervals from five different adult female grizzlies were documented. The average interval was 2.27 years and ranged from two years to four years. Two bears (220 and 257) produced cubs every other year for the period 1978-1984. These two bears account for eight of the 11 intervals in the sample. If we average the intervals for each bear then average all four bears the interval would be 2.6 which probably is a better interval average for the study area. Alternate year cycles, although common for these two bears, were probably less common in the overall population for the Rocky Mountain Front.

Female bear 257 would come into estrous while yearlings were at her side and quickly abandon these yearling litters prematurely during the spring. Female bear 220 also bred during the spring with the yearlings accompanying her, but retained the yearlings at her side throughout the year. Although evidence was weak because not all offspring were marked it did appear that bear 257's litters survived poorly and were involved in several conflict situations during the study.

Two year cycles are not frequently reported in the literature. Craighead et al (1969) reported intervals of two and three years between litters born to young grizzlies in Yellowstone National Park. Mundy and Flook (1970) suggest that grizzlies occasionally produce litters every two years. Courtier (1954) stated that female European brown bears breed every two years although sometimes three years pass between matings. In the Yaak area of Montana a female grizzly recently produced a litter of cubs in 1986 and again in 1988 (Thier and Kasworm, Personal Com.).

Population Trend

The counts of unduplicated unmarked bears and marked bears from the core area ranged from 26 to 36 and averaged 29.5 (S.D.=4.3, 95% C.I.=25.6-33.5) bears (Figure 104). Each year data were examined and compared to the previous years data to look for inconsistencies and the presence of marked bears across each year. There were adjustments made to the data in 1985 to reflect observations made in 1986 (see footnote above). A decreased field effort in the study area occurred in 1985 and as a result, observation efficiency decreased. It is felt that these data represent our best scientific effort to conservatively account for individual bears present each year of the study. The trend detected by the regression of counts of bears was upward slightly but not significantly (P=0.50).

The counts of unduplicated bears from the core area, less the recorded mortality, ranged from 23 to 31 and averaged 27.4 (S.D.=3.46, 95% C.I.=24.2-30.6) bears (Figure 104). These data represent the best estimation of the sustained population from the core area. The trend from the population data was stable as indicated by the regression.

Family group observation data from 1976-87 was examined for trend. Difficulty was met in eliminating duplication in the pre-1980 data so we confined our data examination for this parameter to the number of female with young observed each year from 1980-87. The observations were collected from the project field personnel, federal agencies, and private individuals. The vast majority of observations (87.5%) were reported by project personnel and private individuals. Most (93.8%) of the observations came from USFS and private lands.

Results show that the number of females with young observed increased slightly but not significantly (Figure 105, P=0.39). The average number of females with young observed each year was 9.6 and ranged from a low of eight to a high of 12.

These data were not adjusted across years because they represent observations of unduplicated females with young. Thus, bears present one year could still be detected the next. In addition,

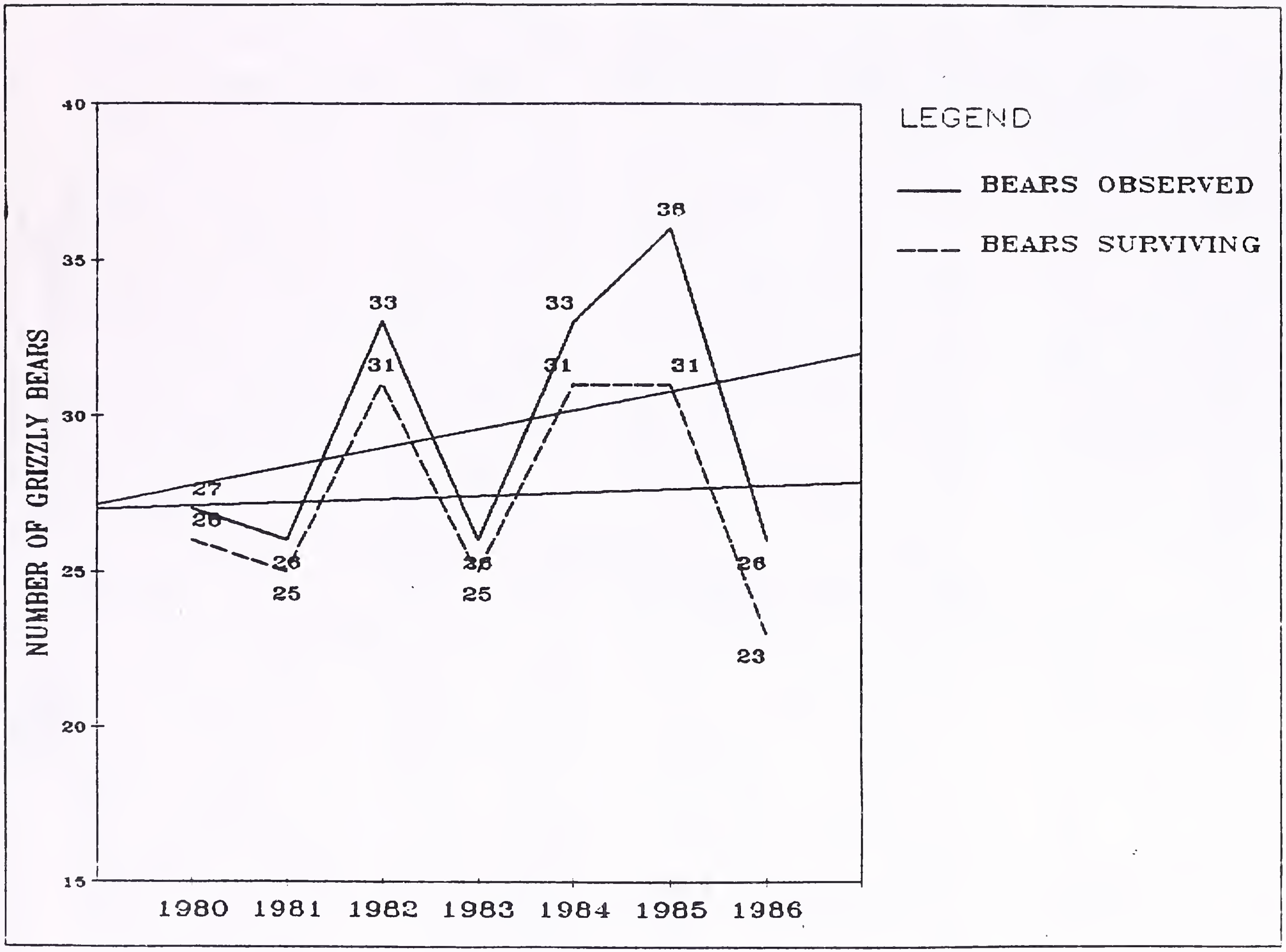


Figure 104. Core area grizzly bear population trend.

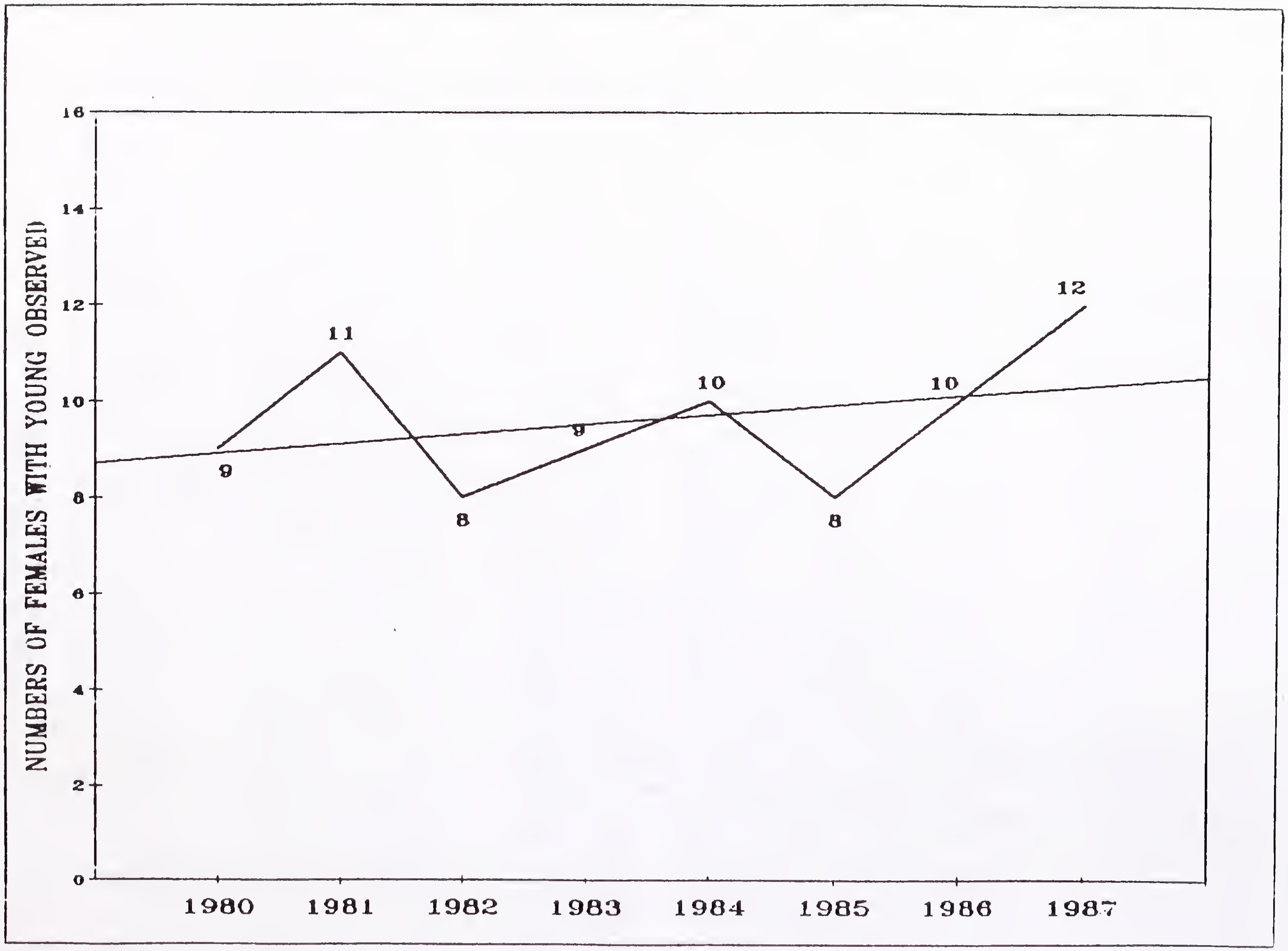


Figure 105. Observations of females with young.

the complexity involved in sorting across years in this data set would only increase the chance of duplication.

One difficulty experienced with the females with young data was evaluating the ability of inexperienced observers to determine between late cubs, yearlings, and two year olds. In fact many observers may consider any group of bears a female with young, when in fact they are not a family group. In addition discerning between individual family groups is difficult at times. We examined the data for consistency of group size, timing of observations and locations. Due to our monitoring records of bears we were also able to discern between some groups by process of elimination.

During the study, we increased our overall area of field work from the smaller core region into adjacent areas to the north and south. This increase in our presence across a larger area coupled with continued monitoring efforts in the core area probably improved our detection efficiency and could account for the increase. To test this, we examined the female observations from the core area and compared them to female observations across the entire study area (Figure 106). A slight downward regression that was not significant was detected in the core area as compared to the slightly upward regression for the entire study area. The difference between the number observed in the core area and adjacent areas did improve slightly in 1986 and 1987 as we expanded our study area emphasis. Most of the increase in observations was probably related to our expanding survey area.

Family group observations were recorded in each of the six BMU's within the study area (Figure 107). The fewest family groups were detected in the South Fork Sun River BMU. It is also within this unit that we had the lowest capture rate. There is likely a density related factor affecting the efficiency of detection for family groups in different regions. Each BMU is probably not equal in the number of bears or family groups present per area. In addition detection effort was not equal in all BMU's.

We examined the female with young data in relation to the population data for the core area. We compared raw observation data collected from direct observation reports and adjusted data using the knowledge of marked bears to correct numbers across years to our population data (Figure 108). Regressions for the population were flat while regressions for the female with young observed (raw) were downward but not significantly (P>0.05). When we adjusted the female with young data from observations with information from marked bears, we saw a stronger regression correlation. These data indicated that observation data alone may have been inadequate to measure the overall population trend.

To reduce the confusion caused by including yearling and two year old family groups in the observations, we examined the observation

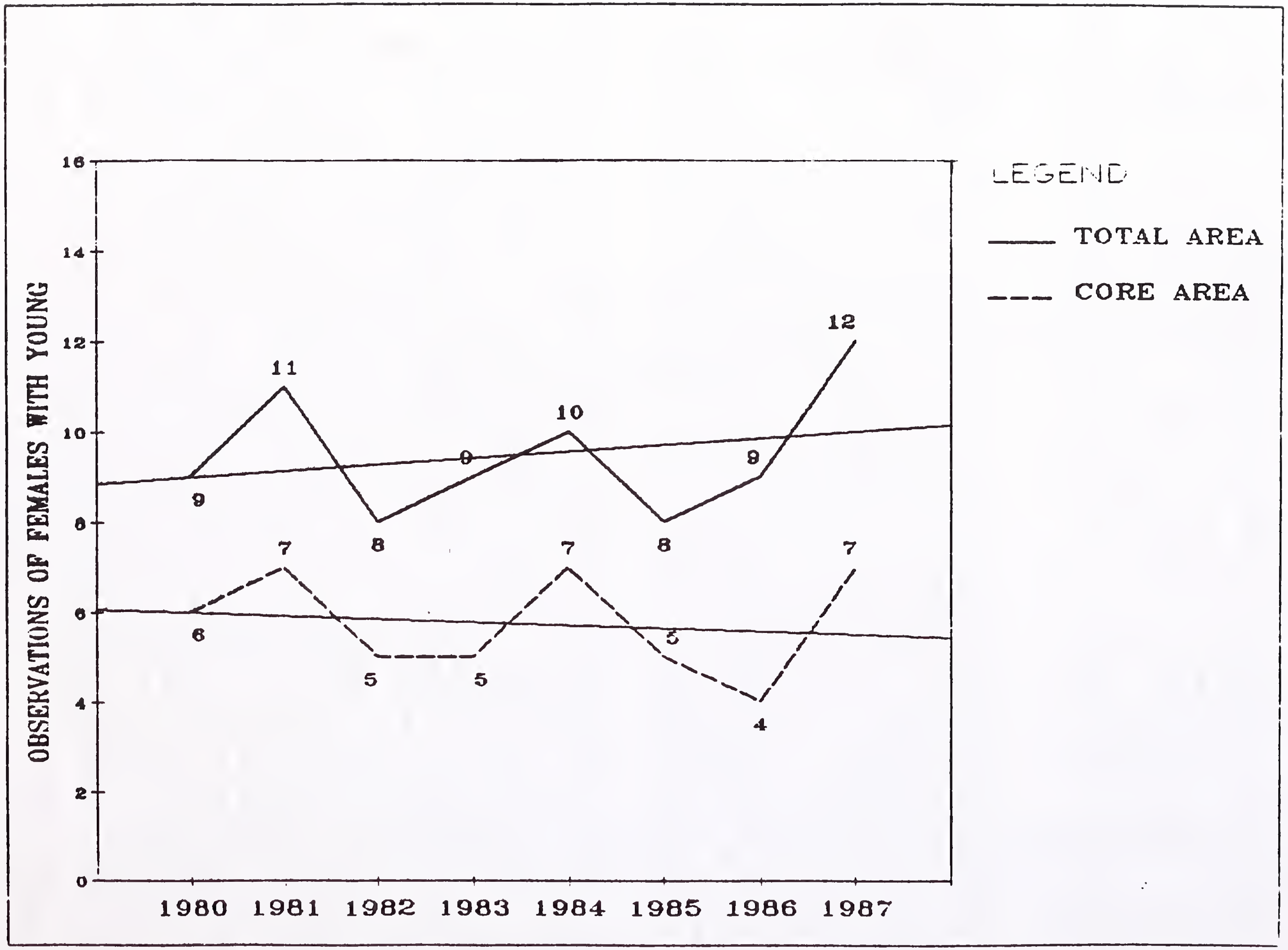


Figure 106. Unduplicated observations of females with young.

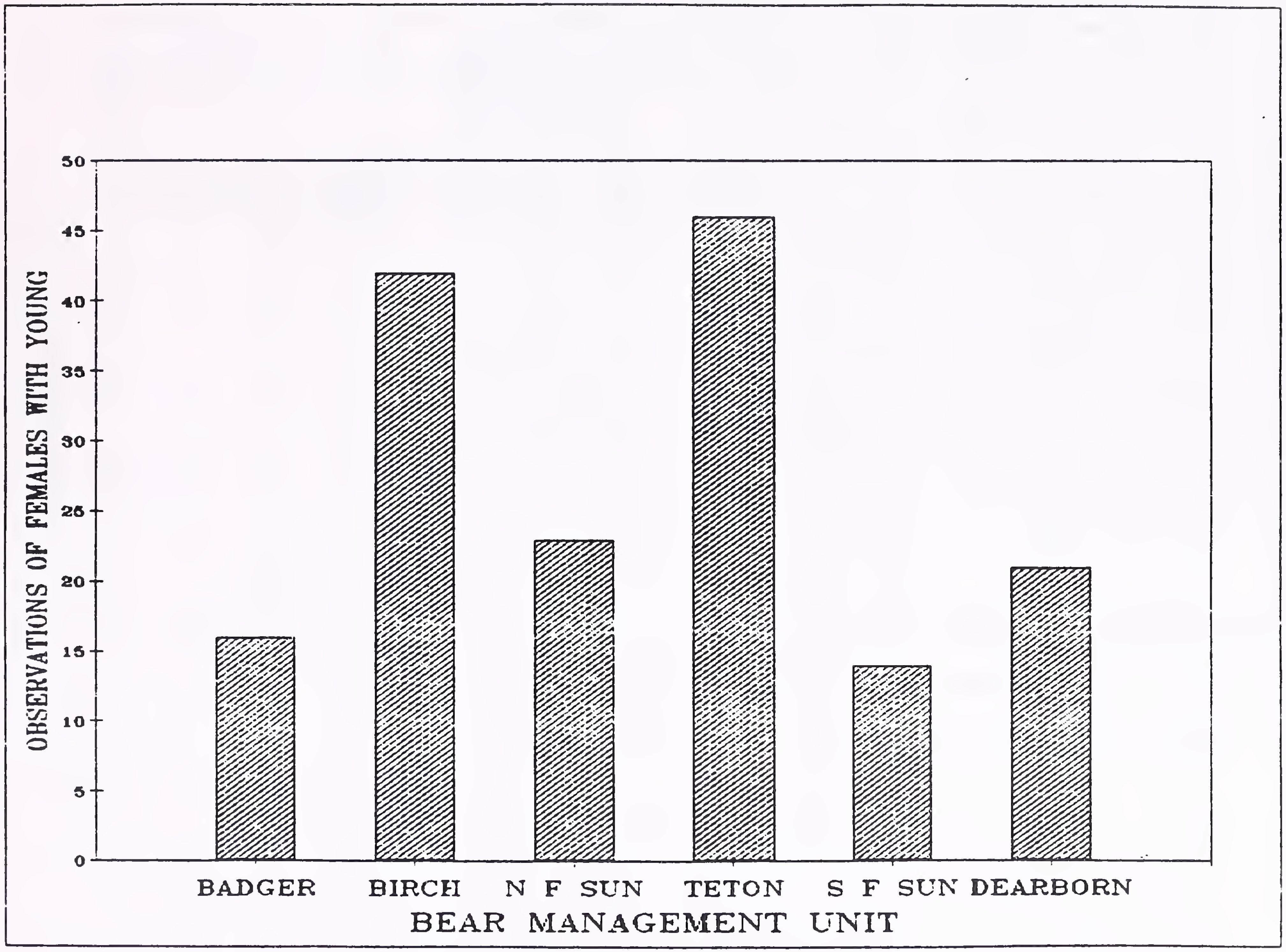


Figure 107. Obervations of females with young, by bear management unit.

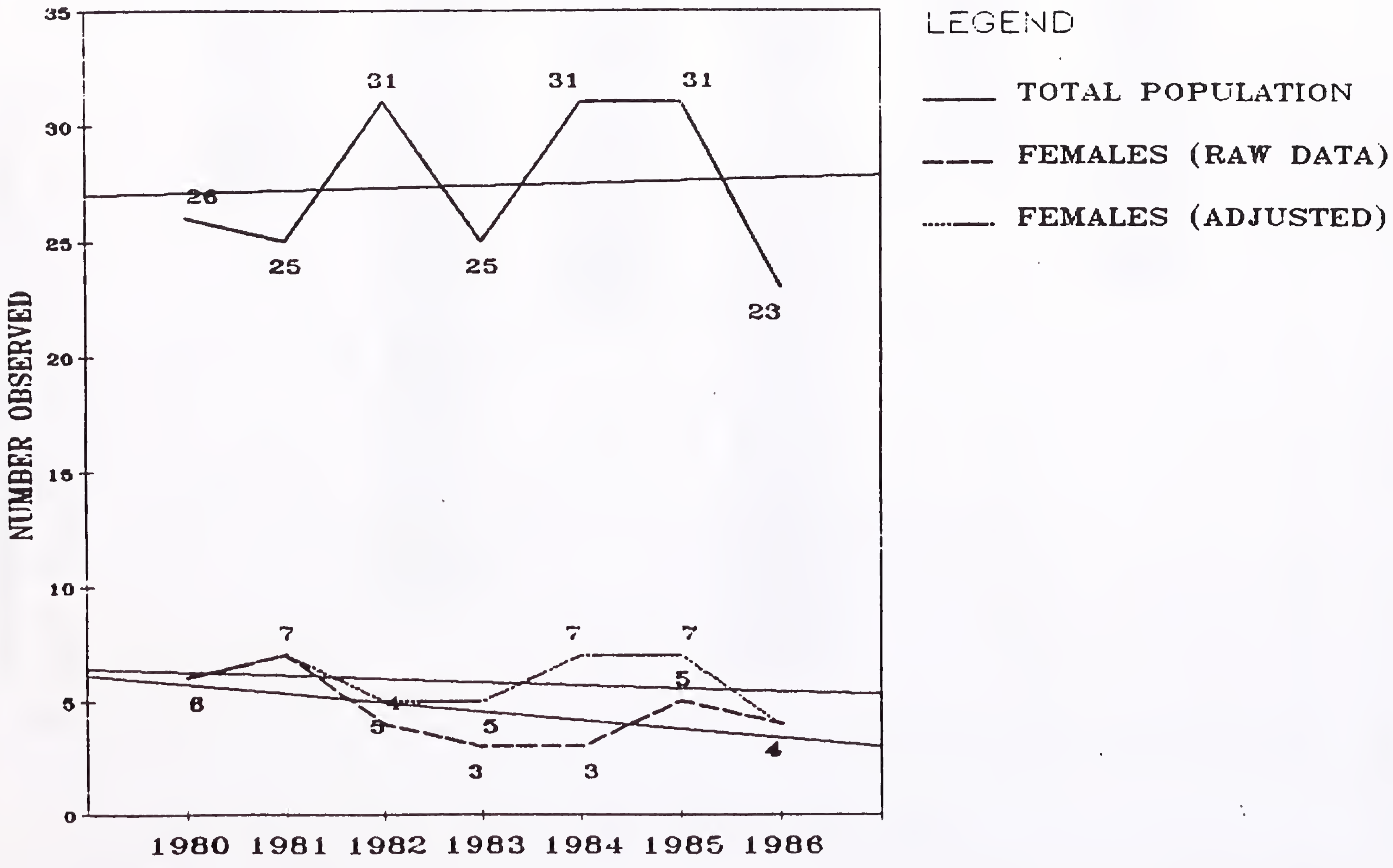


Figure 108. Total population and females with young observed in the core area.

data for females with cubs of the year only and established a regression (Figure 109). The data from 1976-87 was used to develop a long term trend. An adjustment was made in 1985 to provide the best possible data in each year and between years.

The females with cubs observed and recorded ranged from three to eight per year and averaged 5.8 (S.D.=1.71, 95% C.I.=4.7-6.8) for the period 1976-87. No measure was made of observation efforts for each year to equate with the numbers observed. It is likely that increased field effort occurred during the early 80's then tapered off in the last two years of study. Some portion of the increase in the regression probably corresponds to improved knowledge of our study area and documentation of individual home ranges, therefore, increasing observation efficiency. It is believed, however, that these data indicate the presence of a stable and productive adult female segment of the population.

Several researchers suggest that females with cubs may be a possible trend indicator for grizzly bears (Harris 1986, Knight and Eberhardt 1985). We examined the three year sum of females with cubs for the Rocky Mountain Front with data from 1976-87 (Figure 110). The data was adjusted to account for the known two year cycles of some radio marked grizzly bears. Two year cycles in a three year sum could duplicate individuals in the summed value. The three year sum of females with cubs ranged between 11 and 21 with an average of 15.2 (S.D.=2.97 95% C.I.=13.07-17.33) females.

We compared the three year sum of females against the females with young observed for the period 1980-87 (Table 73). These data indicated that in any one year the female with young number represented approximately 66% of the total estimated female population for our study area. There was considerable variation in the proportion of females with young observed and the estimate of females present in the area.

Table 73. Comparisons of 3 year sums estimates of females and females with young for the Rocky Mountain Front, 1980-87.

Year	80	81	82	83	84	85	86	87	Avg.
3 year sum of females w/cubs	11	13	15	21	17	15	12	16	15.2
Female w/young observed and marked	9	11	8	9	10	8	10	12	9.6
Percent	82	85	53	43	59	53	83	75	66.6

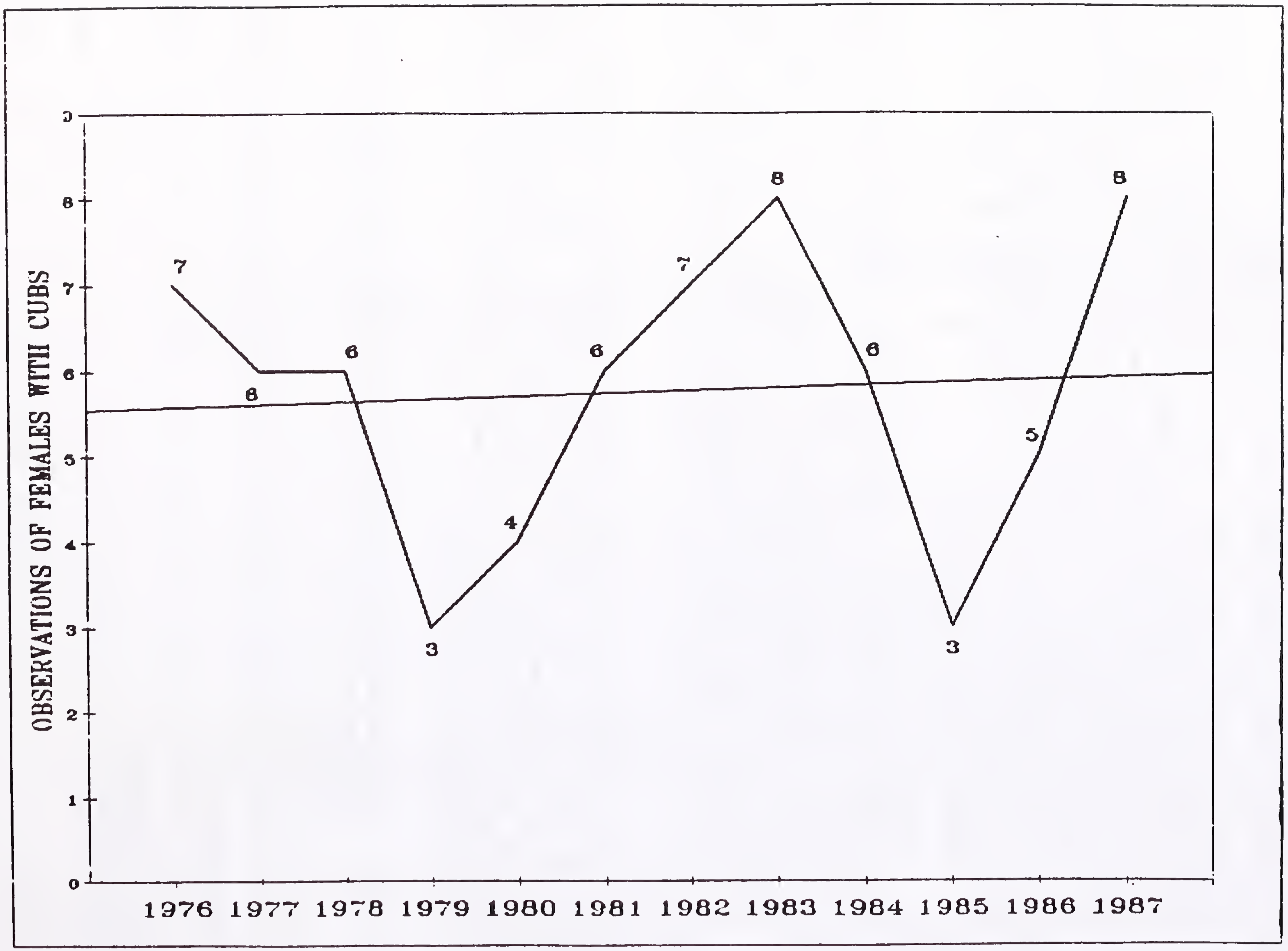


Figure 109. Observations of females with cubs.

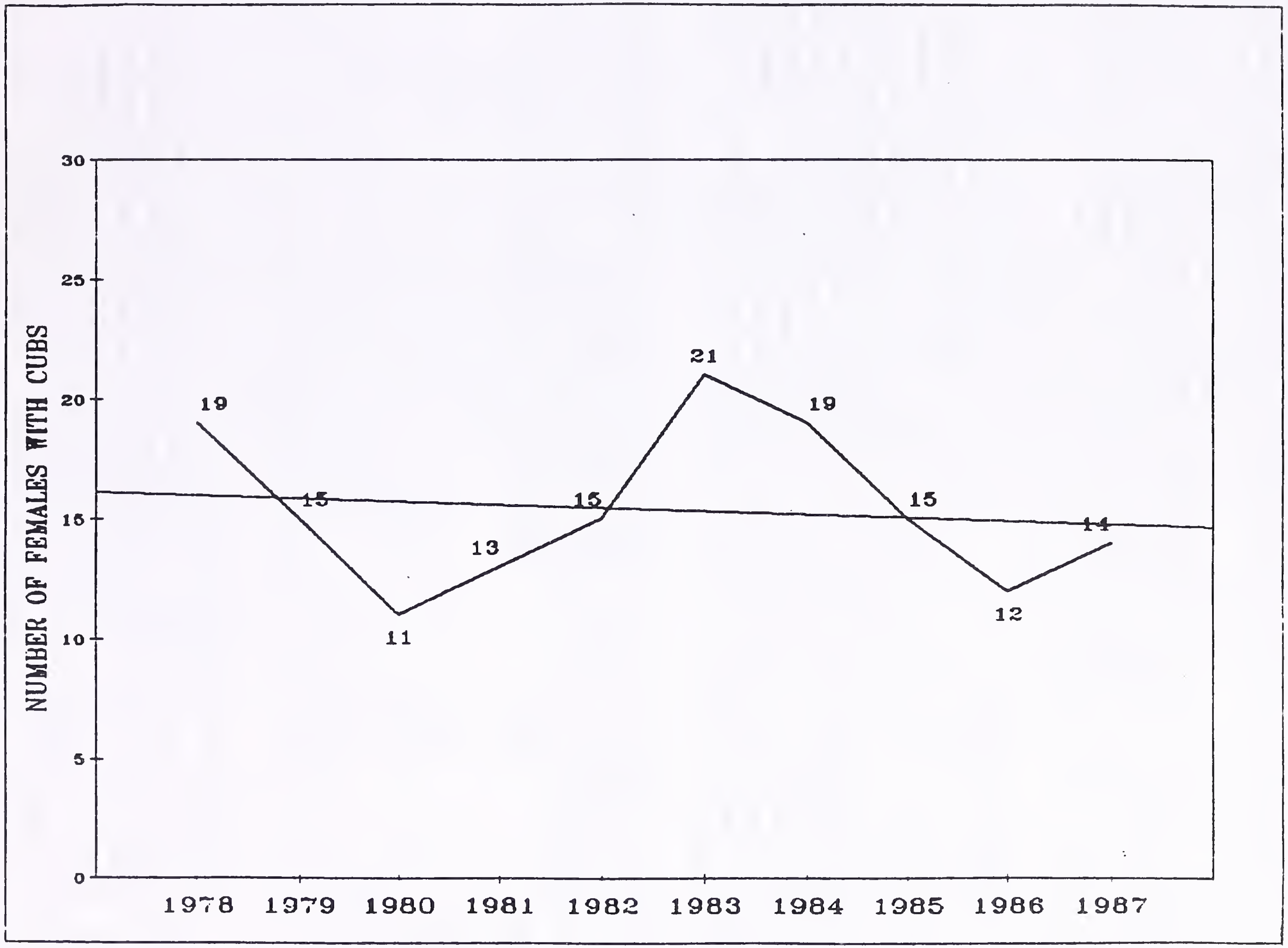


Figure 110. Adjusted 3 year sum of females with cubs.

The trend data examined during this study indicated that a stable or perhaps slightly increasing population existed during 1977-87. These data suggested that the population in the core area may have approached the carrying capacity of the habitat in which the bear is being allowed to exist. The numerous records of subadult dispersal away from the area tend to support this contention. All portions of previously defined bear habitat in the core area were occupied and home ranges of adult aged reproducing females occurred throughout. Due to the quality of habitat and the social tolerance limits of humans along the front, it is doubtful that the population would be able to significantly increase in numbers or expand in distribution from its present status.

Minimum Counts

For areas outside the core area, we were able to enumerate a minimum count for bears present (Table 74). These data were not of the quality and consistency of the marked-unmarked counts for the core area because of the limited number of marked bears present and the inconsistent efforts in conducting radio tracking surveys in these regions. The counts produced, however, will give some minimum numbers of individual bears present on the Badger-Two Medicine area and the area south of the Sun River. Data were examined across years to make adjustments for marked bears present across years.

Table 74. Minimum counts of grizzly bears identifiable in each region of the study area, 1984-1986.

Year	Core area	Badger-Two Medicine	South Sun River	Total
1984	33	7	14	54
1985	36	6	15	57
1986	26	8	12	46
Average	31.6	7.0	13.6	52.3
95% C.I.	18.9-44.4	4.5-9.5	9.9-17.5	38.2-66.5

Recruitment and Dispersal

Seven male subadult bears monitored during the study dispersed. Two individuals left the study area entirely with one moving into the Middle Fork of the Flathead and the other moving south into the Blackfoot River drainage. The remainder established home ranges in a region of the Rocky Mountain Front other than their natal ranges.

Six of seven subadult male bears dispersed from the core area during the course of the study. Three of these moved into the Badger-Two Medicine area while two moved into the region south of the Sun River. One bear from the core area moved outside the Rocky Mountain Front study area.

Only one case of immigration into the study area has been reported. Male bear 229 moved into the area south of the Sun River from the Mission Mountains. Few studies were being conducted adjacent to our study area during the project reducing the opportunity to detect immigration.

One case of a young male bear moving far east out onto the prairie may be related to subadult dispersal. Bear 342 moved east out onto the irrigated bench near Fairfield. His movements indicated that dispersal can potentially occur in all directions on the Rocky Mountain Front.

From 1980-87 records indicated that nine marked bears were recruited into the Northern Continental Divide population. These include four males and five females. Eight of these were recruited into the study area while one dispersed and was recruited into the Middle Fork Flathead. Three females were recruited during the study into the core area. Three males were recruited to the region south of the Sun River. Two females were recruited into the Badger-Two Medicine.

The observed recruitment of marked bears to the study area averaged one bear per year. Average rate of recruitment of marked females to the study area was 0.625 female per year. Recruitment rates established here were minimum and could be two to three times higher than that which we detected.

Mortality and Survivorship

Records were collected from 43 mortalities on the Rocky Mountain Front from 1977-88. Mortality from 1988 was included in this analysis. New information was available pertinent to the analysis. The reader should be warned that this is inconsistent with most other data presented in this report. The average annual known mortality for this period was 3.58 bears and ranged from one to eight. The mortalities included 11 Females, 27 males, and five of unknown sex. The average annual adult female mortality was 0.5. Of the 11 females killed six were adults and five were subadults for adult/subadult ratio of 55/45. For males there were nine adults and 18 subadults killed for a ratio of 33/66. Five bear mortalities were reported with no sex or age data. These were a decomposed illegal kill, a yearling observed to be absent from a litter of a marked bear and a litter of three cubs lost by a marked bear.

The age structure of the mortalities was skewed heavily towards subadults (Figure 111). Bears of ages one through 20 were represented in the sample. It appears that there was a trough in

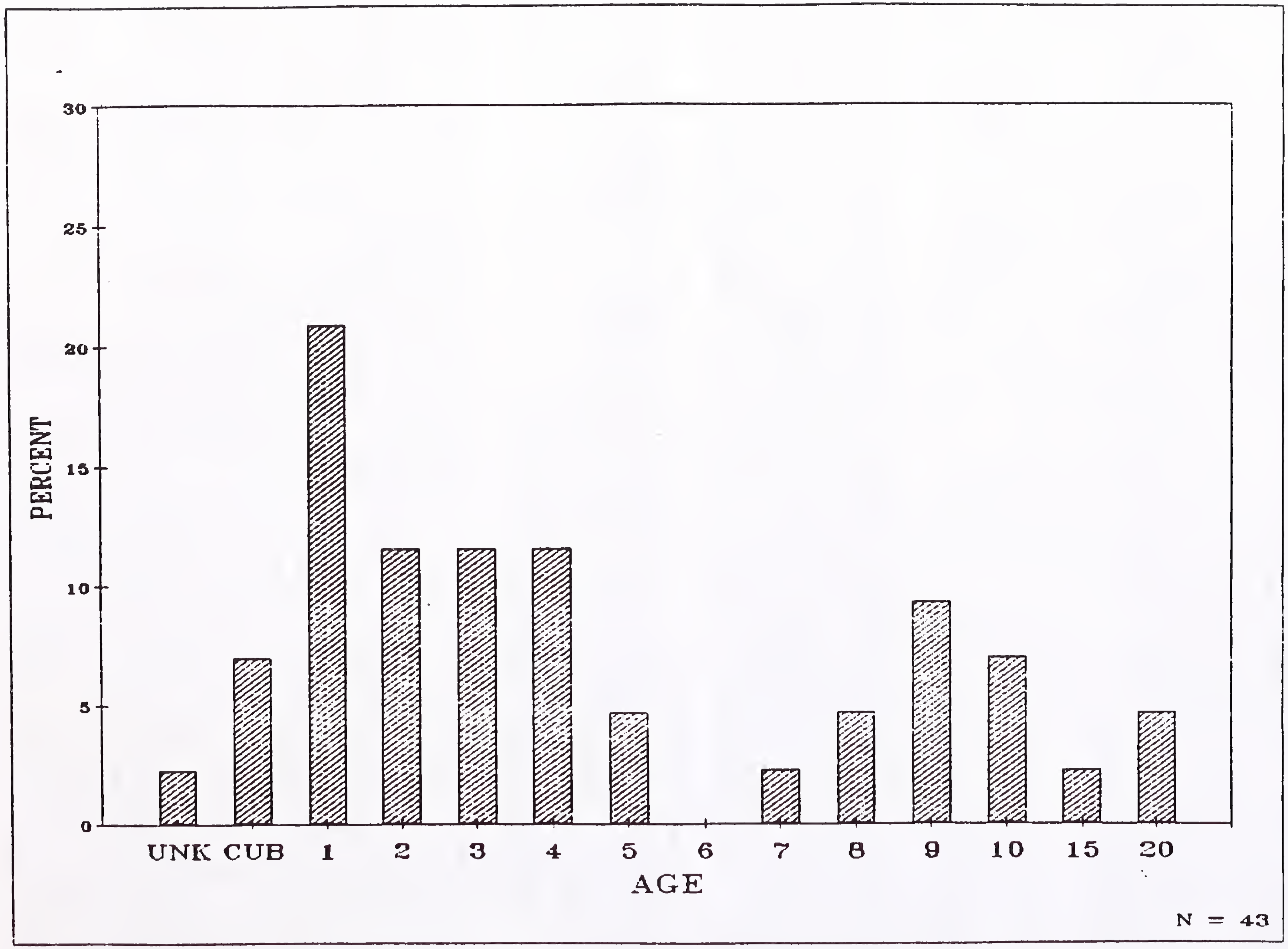


Figure 111. Age distribution of grizzly bear mortality.

the distribution around age five to eight. The older aged bears appearing in the graph were primarily males.

Mortality records included all bears unmarked, marked research bears, and marked management bears. Sixteen of the bears killed (37.2) had some history of conflict with humans. Twenty-one (48.8%) of the bears were not known to have had any conflict with humans during the course of the study. The remaining six (14%) had limited historical backgrounds (i.e. cubs/yearlings and natural deaths).

The distance to the nearest road was determined for each mortality site (Table 75). Bears killed within 1 km. of a road represented 62.8% of the total kill while 37.2% of the bears were killed greater than 1 km. from a road. All but one female mortality was within 1 km. of a road.

Bear mortalities were classified as research, natural, illegal, management, or hunting (Table 75). Management control actions were the leading cause of mortality and contributed 35.8% of the total mortality. Hunting and illegal kills composed 28 and 31% of the total mortality. Five natural caused deaths were recorded in the study. One involved a marked bear killed by a larger male. The second case is an assumed mortality observed in a litter of yearlings. In this latter case no actual carcass was observed, however, the cause of death was classed as natural considering that the female had been breeding with a male while attending her litter of three and later was observed with a litter of only two. The third case involved an entire litter lost to bear 366. She was observed with cubs in a very remote backcountry setting until late May. She was then reported with a larger bear, presumed to be a male, without any cubs. Previous observations and ground inspections confirmed that she had lost her entire litter. We assume the loss to some natural phenomenon possibly related to the male companion observed with her.

A regression of mortalities per year from 1977-88 showed an increasing slope with a slope approaching significance (P=.06) (Figure 112). A conspicuous increase in annual mortality was noted for 1980 and 1984-87. Examination of precipitation records and review of field notes indicated that these were drought years and resulted in poor berry production. In addition, declining social tolerance toward bears on the private lands along the front caused a significant change in management programs. Illegal kills recovered by our studies increased significantly during this period.

An analysis of mortalities from radio collared animals was conducted using the Micro-mort program (Heisey and Fuller 1985) for data from radio monitored bears captured and marked during research capture efforts, 1977-87. Mortalities were classed as natural, hunting, illegal, nuisance, livestock, and capture. Three cases

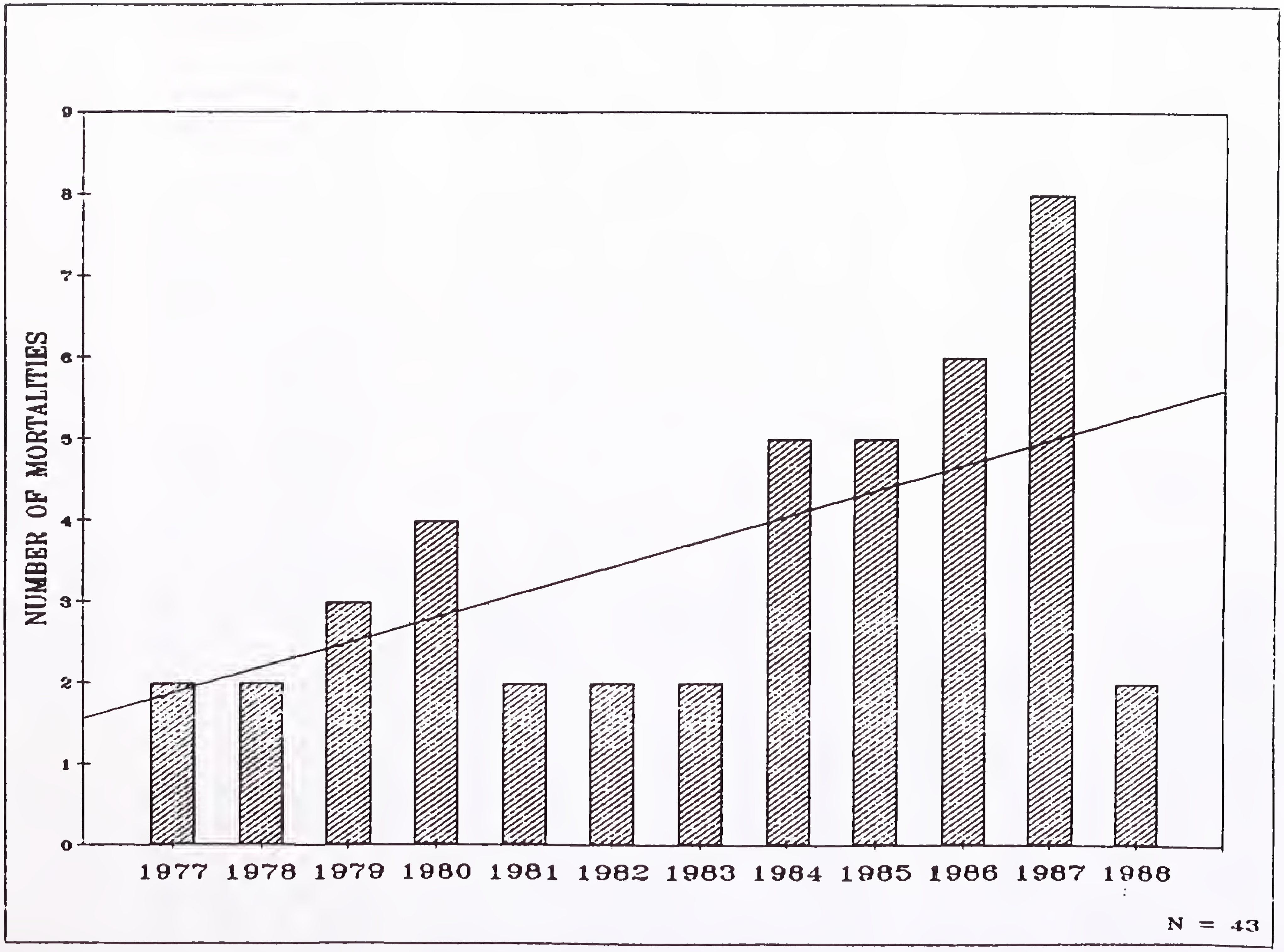


Figure 112. Grizzly bear mortality trend.

were found in which the fate of bears were not known following our last radio contact. We conducted an analysis assuming all these three survived and a second analysis assuming all three did not. Thus the results are presented with a maximum survival rate and a minimum survival rate.

Table 75. Grizzly bear mortalities in relation to roads, 1977-88.

	Greater than 1 km.	Less than 1 km.	Total
Sample size	16	27	43
Males	10	17	27
Females	1	10	11
Unknown	5	0	5
Adults	7	8	15
Subadults	5	19	24
Cubs	3	0	3
Unknown	1	0	1
Cause of Mortality			
Research	1	0	1
Natural	5	0	5
Illegal	3	9	12
Management	1	13	14
Hunting	6	5	11

We included all cubs and yearlings which were with radioed females in the analysis until they were weaned or fitted with a radio transmitter, in which case their monitoring was continued. During the time with the female they were assigned the same radio days as the female. The analysis was conducted by sex and age classes on an annual basis.

We assigned radio days for four intervals including spring, summer, fall, and the winter period. Radio days were assigned to periods by using the median emergence and entrance dates into dens as cutoff points. Spring ran from den emergence (April 7) to the end of June. Summer included the months of July and August. Fall was assigned the period from September 1 until den entrance (November 6). Winter was the interval between den entrance and den emergence. Radio days were assigned as: spring-85, summer-62, fall-67, and winter-151.

Total radio days from our sample from 1977-87 was 12,684 (Table 76). We recorded 17 known mortalities from marked grizzlies or cubs/yearlings of marked grizzlies. There were three unknown fates applied to the analysis of maximum and minimum survival rates.

Table 76. The number of radio days applied in the analysis by sex and age groups, 1977-87.

	Spring	Summer	Fall	Total
Cub/yearling	3361	1893	2014	4228
Subadult	1573	1546	1534	3171
Adult	3281	2752	2620	5285
Male	1805	1667	1387	2416
Female	3049	2631	2767	6040
All Bears	8215	6191	6168	12684

The minimum annual survival rate calculated for all bears annually was 0.835 while the maximum annual survival rate was 0.862 (Table 77). Summer survival rates were higher but not significantly higher than spring and fall survival rates. No mortalities were recorded during the winter interval so winter survival rates were 1.00 for all years and for the span of the study. Males had lower survival rates than females but 95% confidence intervals overlapped indicating that the difference was not significant. The only mortality detected in the female segment of the population was during the fall.

Table 77. Minimum and maximum survival rates for all bears, males and females on the Rocky Mountain Front 1977-87.

	Males	Females	All bears
Spring			
Max.	.910 (.799-1.0)	1.0 (-)	.930 (.881-.981)
Min.	.868 (.740-1.0)	1.0 (-)	.921 (.869-.975)
Summer			
Max.	.963 (.869-1.0)	1.0 (-)	.990 (.971-1.0)
Min.	.963 (.869-1.0)	1.0 (-)	.990 (.971-1.0)
Fall			
Max.	.865 (.734-1.0)	.953 (.891-1.0)	.937 (.889-.987)
Min.	.865 (.734-1.0)	.930 (.856-1.0)	.917 (.863-.974)
Annual			
Max.	.758 (.607-.947)	.953 (.891-1.0)	.862 (.798-.932)
Min.	.723 (.569-.920)	.930 (.856-1.0)	.835 (.767-.910)

( ) equals 95% confidence intervals.

Subadult males had the lowest annual and seasonal survival rates of all sex and age classes (Table 78). Adult females had the highest survival rates for all bears in all seasons. Mortality rates in all sexes were lower during the summer than during the spring and fall.

Annual mortality rates for each year ranged from 0 to 46% (Table 79). A maximum rate was calculated assuming all marked bears whose fate was unknown were dead. A minimum rate includes only known mortalities and assumes all marked bears, whose fate was unknown, survived. Consistent with the numbers of bears killed annually, we detected a significant increase in mortality toward the end of the study. The regression of annual mortality rates from 1977 to 1987 was increasing for both the maximum and minimum mortality rate estimates. The slope in each regression was significant (Max.; P=0.054, Min.; P=0.117).

Table 79. Annual mortality rates calculated for each year, 1977-87.

		Mortality Rate	
Year	Radio-days	Maximum	Minimum
1977	735	0 (-)	0 (-)
1978	1219	0 (-)	0 (-)
1979	965	.315 (0 -.674)	.315 (0 -.674)
1980	2554	.133 (0 -.345)	.133 (0 -.345)
1981	2054	0 (-)	0 (-)
1982	5174	.132 (0 -.286)	.132 (0 -.286)
1983	4645	.210 (0 -.395)	.076 (0 -.208)
1984	6453	.107 (0 -.237)	.107 (0 -.237)
1985	4277	.157 (0 -.335)	.082 (0 -.223)
1986	3213	.203 (0 -.419)	.203 (0 -.419)
1987	2372	.460 (.013-.705)	.460 (.013-.705)

( ) equals 95% confidence intervals.

The rate of mortality attributable by each class of mortality ranged between a high of .049 for natural mortality and a low of .010 for capture and nuisance mortalities. The annual mortality rate for management removals (nuisance and livestock classes combined) and illegal mortalities was 0.057-0.058. These classes of mortality represent the causes of mortality directly attributable to human/bear conflict. Total known man caused mortality was 0.087-0.115 annually assuming in the latter case that all unknown fates died by man caused actions.

Table 78. Maximum and minimum survival rates by sex and age groups for the Rocky Mountain Front, 1977-87.

	Cub/ Yearling	Subadult male	Adult male	Subadult female	Adult female
Spring					
Max.	.881 (.789-.984)	.918 (.776-1.0)	.901 (.734-1.0)	1.0 (-)	1.0 (-)
Min.	.881 (.789-.984)	.842 (.664-1.0)	.901 (.734-1.0)	1.0 (-)	1.0 (-)
Summer					
Max.	1.0 (-)	.933 (.815-1.0)	1.0 (-)	1.0 (-)	1.0 (-)
Min.	1.0 (-)	.933 (.815-1.0)	1.0 (-)	1.0 (-)	1.0 (-)
Fall					
Max.	.967 (.906-1.0)	.836 (.653-1.0)	.900 (.732-1.0)	.918 (.776-1.0)	.967 (.905-1.0)
Min.	.936 (.853-1.0)	.836 (.653-1.0)	.900 (.732-1.0)	.918 (.776-1.0)	.935 (.851-1.0)
Annual					
Max.	.852 (.749-.969)	.716 (.516-.995)	.811 (.606-1.0)	.918 (.776-1.0)	.967 (.905-1.0)
Min.	.824 (.749-.969)	.657 (.455-.951)	.811 (.606-1.0)	.918 (.776-1.0)	.935 (.851-1.0)

( ) equals 95 percent confidence intervals.

Table 80. Causes of mortality and associated rates for grizzly bears on the Rocky Mountain Front, 1977-87.

Class	Maximum	Minimum
Survival	.835 (.767-.910)	.863 (.798-.932)
Natural	.049 (.007-.092)	.050 (.007-.093)
Hunting	.019 (0 -.045)	.019 (0 -.046)
Illegal	.028 (0 -.060)	.029 (0 -.061)
Nuisance	.010 (0 -.029)	.010 (0 -.045)
Livestock	.019 (0 -.044)	.019 (0 -.045)
Capture	.010 (0 -.029)	.010 (0 -.029)
Unknown fate	.029 (0 -.061)	- - - - - - - -

Bunnel and Tait (1985) report annual survival rates for grizzly populations from 0.72 to 0.90. An annual adult female survival rate of 0.86 (estimated by computer simulations) was necessary to maintain a population of grizzlies in the Yellowstone ecosystem (McCullough 1981, Knight and Eberhardt 1985). Knick and Kasworm (1989) report annual survival rates of males from 0.53-0.86 and females from 0.89-1.00 for the Selkirk and Cabinent Yaak ecosystems where population densities are very low. In our study area survival rates appeared adequate to maintain the population. Increasing mortality further could result in a declining population, however, high survival rates and productivity of the adult females may compensate for increased mortality in the male segment of the population.

The proportion of radio marked bears advancing into the next age class for bears over all years and aged cub through five was determined (Figure 113). Mortality is higher in males than in females and the proportions appeared similar to survivorship calculations using the Micro-mort program. Specifically it appeared that male bears in the particular ages three and four experienced reduced survivorship. A decrease in survivorship of females of the ages two and three were noted but by age four survivorship increased.

Density Estimation

We derived modified minimum composite polygons for each of the three areas were radio telemetry work was conducted including; the Sun River South, The Teton-Birch (core area) and the Badger-Two Medicine for each year surveyed between 1980-1987. Due to inconsistent field effort we did not use the polygons for 1980 and 1987 to develop estimates on the core area. In addition data from the Badger-Two Medicine and Sun River South prior to 1983 were insufficient for density estimate analysis.

Density estimates were derived from 1981-86 in the core area and from 1984-86 in the Badger-Two Medicine and Sun River areas (Table

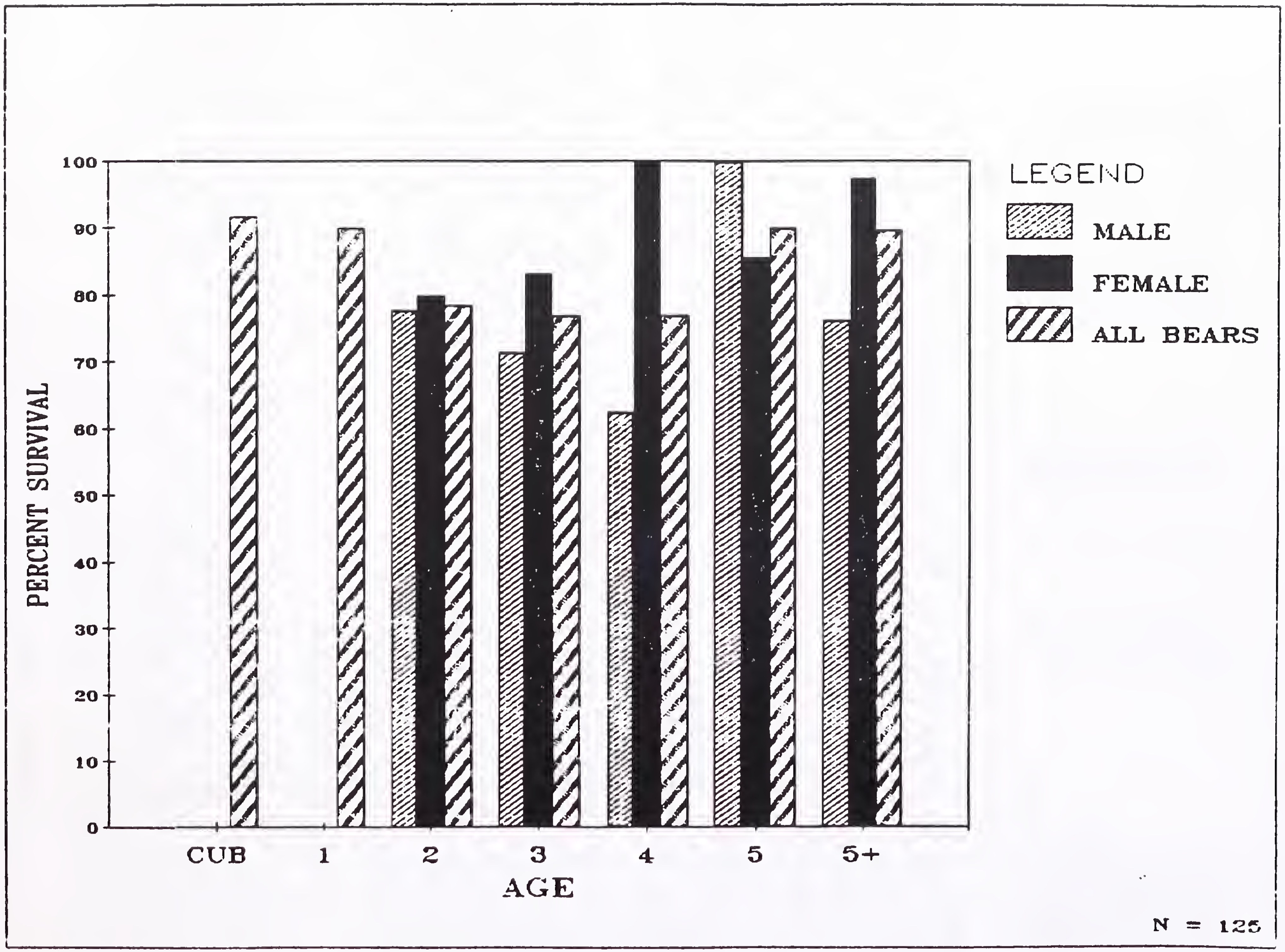


Figure 113. Survival of marked grizzly bears to the next age class.

81). Examination of the composite polygons for these years revealed a fairly consistent survey area size and survey area location which may account for the consistent numbers of bears sited between these years for each survey area. The number of marked bears varied considerably during these years especially in the Sun River area. The number of marked bears was dependent upon the trapping efforts which varied annually in location and effort.

Table 81. Grizzly bear density estimates for three area's of the Rocky Mountain Front, 1981-86.

	Modified survey area	Number marked bears	Density (km.^{2}/ bear)	Modified boundary area	Total marked/ unmrked	Density (km.^{2}/ bear)
Core area						
1981	1883.4	12	157.0	4078.3	26	156.9
1982	2633.3	19	138.6	5025.1	33	152.3
1983	1585.8	21	75.5	3437.7	26	132.2
1984	1940.4	26	74.6	4400.7	33	133.3
1985	1924.5	22	87.5	3978.6	36	110.5
Mean			106.6			137.0
95% C.I.			58.9-154.4			114.1-160.0
Sun River						
1984	1366.1	2	683.1	5027.4	14	359.1
1985	2403.8	6	400.6	5656.0	15	377.1
1986	1670.8	8	208.9	4938.3	12	411.5
Mean			430.9			382.6
95% C.I.			-161.7-1023.4			316.4-448.7
Badger-Two Medicine						
1984	474.8	5	95.0	1364.7	7	195.0
1985	393.7	4	98.4	1248.3	6	208.1
1986	618.2	6	103.0	1747.0	8	218.4
Mean			98.8			207.2
95% C.I.			88.8-108.8			178.0-236.3

* All areas are km^{2}.

The highest annual density estimate was one bear per 74.6 sq. km. (22.7 sq. mi.) for the core area in 1984. The lowest was one bear per 683.1 sq.km. (208.2 sq. mi.) for the Sun River in 1984 when only two marked bears were present on the area. The density estimates using marked bears only generally defined a density higher than estimates with marked and unmarked bears. The obvious exception was the 1981 estimate for the Sun River when the number of marked bears was low enough that the estimate was of questionable value.

AOV indicated that there was no difference ($P<0.05$) in the mean density of marked bears between the Badger-Two Medicine and the core area but significant difference with the Sun River area where the density was much lower. AOV indicated that there was a difference ($P<0.05$) in the mean density of marked plus observed bears with the Core Area having the highest density followed by the Badger-Two Medicine and the Sun River. This latter trend is supported by trapping effort data which suggests that there were lower densities of bears in these two areas also.

The marked plus observed bear density estimates were generally less variable than the marked only, however, the estimates based upon marked bears may be a more accurate estimator of the actual bear density when a sufficient sample of bears is obtained since it is dependent on an absolute bear number per defined area. The marked plus observed numbers generated for density estimates were more dependent upon observation efficiency, therefore, the number of bears seen and marked is a minimum estimate of bears present on the survey area and boundary strip.

To examine marked plus observed density estimation using a boundary strip we looked at the survey efficiency and its possible influence on density estimates for these three areas. We assumed in the worst case our survey efficiency only 40% efficient and in the best case 80%. Estimates were recalculated with bear numbers based on survey efficiency (Table 82).

Density estimates using a marked plus observed count with a boundary strip area could vary by two to three fold depending on the survey efficiency. The marked plus observed density estimates with a survey efficiency of 50-60% were most similar to the density estimates areas using only the marked bears.

The data indicated the importance of having a sufficient sample of marked bears to estimate density. In our study area south of the Sun River we were unable to maintain a marked sample above 40% of the total observed. In the northern areas the marked bears averaged 65-70% of the total observed. The densities were highest when we approached 75-80% marked bears in the survey area.

In conclusion, the modified minimum composite range seemed a better estimator of surveyed area because it excluded a few extraneous points from the definition of the area. These few points and rare radio location flights to these points did not contribute to the observations of unmarked bears and are weighted heavily in convex composite ranges. Probability contours or core area analyses are other methods of composite range analysis which may smooth out the definition of surveyed areas when radio telemetry is being used as the survey technique and results analyzed to provide a density estimate.

Table 82. Density estimates (km^2/bear) for different survey efficiencies using the boundary strip area and marked plus observed bear counts on three areas of the Rocky Mountain Front, 1981-86.

	Efficiency				
	40	50	60	70	80
Core area					
1981	62.7	78.4	94.1	109.9	125.5
1982	60.9	76.1	91.4	106.7	121.8
1983	52.9	66.1	79.4	92.6	105.8
1984	53.3	66.8	80.3	105.5	106.6
1985	44.2	55.3	66.5	77.4	88.4
Range	44.2 - 125.5				
Sun River					
1984	143.6	179.6	216.3	251.4	287.3
1985	150.8	188.5	227.1	264.3	301.7
1986	164.6	205.8	247.9	288.8	329.2
Range	143.6 - 329.2				
Badger-Two Medicine					
1984	78.0	97.8	121.8	136.5	156.0
1985	83.2	104.0	130.0	145.2	166.4
1986	87.4	109.2	136.5	156.0	174.7
Range	78.4 - 174.7				

Consistent and frequent radio location flights in similar areas yielded consistent observations of unmarked bears in this study and appeared to provide a reasonable means of determining minimum bear densities when no other survey method is available. The most accurate estimates were those using marked bears, when a large sample of marked bears is present. Marked plus observed bears sampled within a boundary strip area yielded very low density estimates but could be modified when survey efficiency is known to provide reasonable density estimates.

Bear Human Conflict Management

From 1977-87 records were kept on all reported bear/human conflicts in the study area. Prior to 1985, reports were presented to the responsible agencies and the study personnel while after 1985 changes occurred in management which may have increased the reporting of conflict situations. In 1985, a livestock indemnity program began and in 1986 a specialist was hired by the MDFWP to manage problem bears.

Twenty one problem grizzlies were captured during the study period. These included 17 males (81%) and 4 (19%) females. Subadults comprised 86% of the bears captured during problem situations (Figure 114).

Ninety one records of conflict situations were gathered during the study (Table 83). The most frequently reported class of bear/human conflicts involved cattle depredations. Conflicts related to livestock comprised 44.0% of the reports. Approximately 40% of the reports involved some type of property damage other than livestock. Nuisance reports involved mostly bears near cabins, homes or communities.

Table 83. The frequency of each class of bear/human conflicts for the Rocky Mountain Front, 1977-87.

Class	Frequency	Relative percent
Livestock		
Cattle depredation	22	24.2
Sheep depredation	16	17.6
Other livestock	2	2.2
Property damage		
Hunter camps	16	17.6
Cabins/homes	13	14.3
Fruit trees	2	2.2
Apiaries	5	5.5
Nuisance		
Near garbage dumps	6	6.7
Near people/homes/cabins	7	7.7
Other	2	2.2

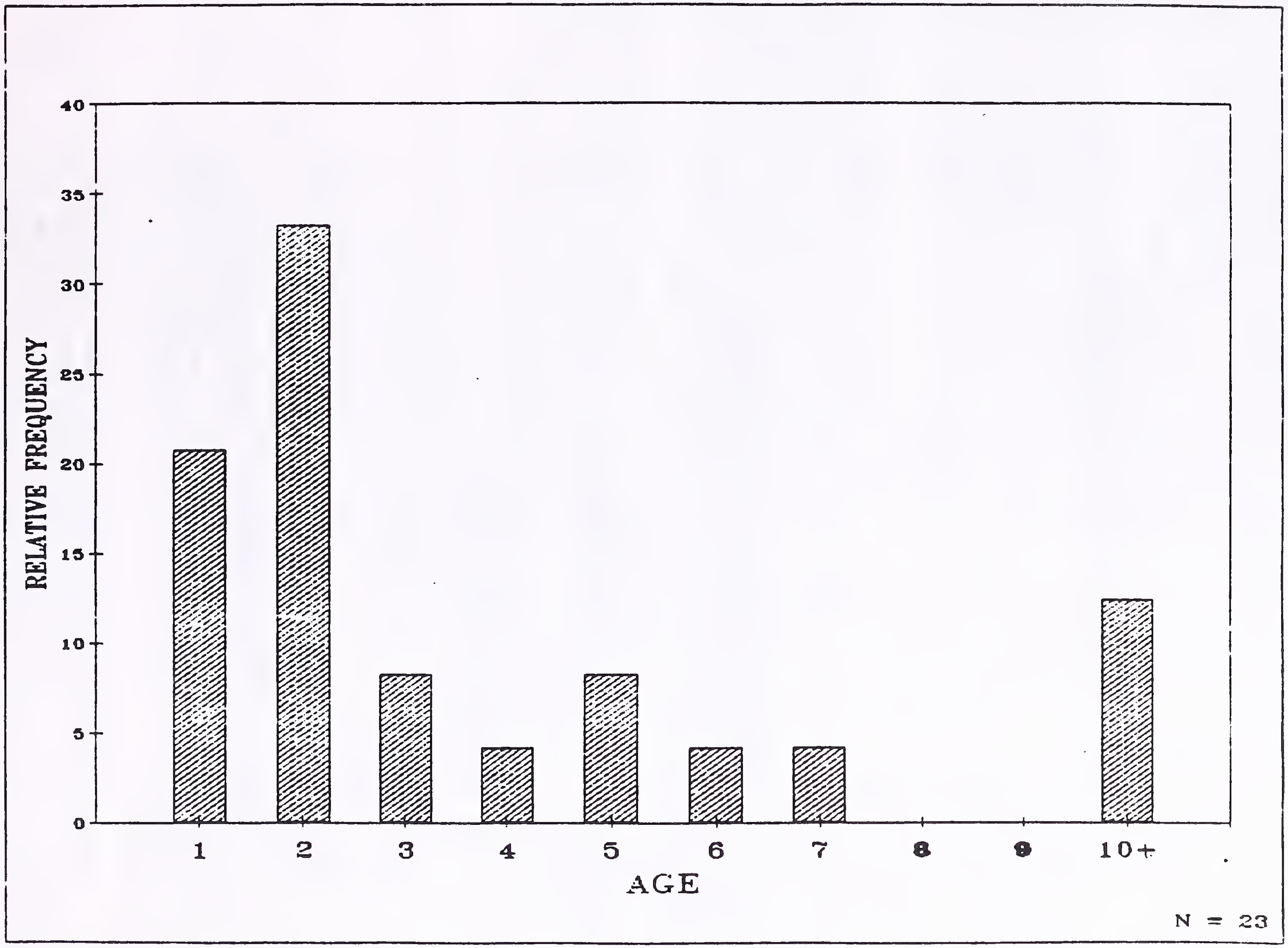


Figure 114. Age distribution of problem grizzly bears.

Conflict situations were reported in each of the six BMU's along the Rocky Mountain Front and two adjacent BMU's in the wilderness (Figure 115). The BMU's with the most problems were the Teton-Sun, Teton-Birch, Badger-Two Medicine, and the Dearborn-Elk Creek. The bear densities in the Teton-Birch and Teton-Sun BMU's and proximity of these grizzly bears to livestock operators along the front may explain the high rate of conflict. Bear densities are considerably lower in the Badger-Two Medicine and Dearborn-Elk BMU's, however, and problems were still prevalent.

One difference in the Dearborn-Elk Creek area as compared to the Teton-Birch and Teton-Sun is the increased amount of forested and mountainous terrain suitable for grizzlies that is privately owned. The demarcation of mountain and prairie is more distinctly divided into public and private domain in the northern half of the study area. This may lead to less livestock present year around on bear habitat to the north while the southern region of our study area is more heavily utilized by livestock.

The management of livestock year around on ranges which are occupied by grizzlies increases the probability of depredations even with low density bear populations. All three of these BMU's have a considerable portion of the spring range privately owned and reported the most bear nuisance situations as well. The Badger-Two Medicine problems were primarily related to consistent conflict situations with sheep grazing along the front ranges on forest leases and adjacent Blackfoot Reservation lands.

A considerable portion of the problem situations in the Badger-Two Medicine BMU's and most of the reports in the North Fork Sun River, Middle Fork Flathead, and Continental Divide BMU's involved recreationists, particularly hunters and hunting camps. We did not receive reports from all of these situations which developed on the study area but records show problems occurred in every year.

We examined reports of conflict situations for each month (Figure 116). September and May were months with particularly significant numbers of conflict situations.

Bear human conflicts were sorted to determine if there was a trend in numbers of conflicts relate to the trend in populations along the front. Each bear incident represented here is compiled from a total report list and combines reports caused by one bear into a single bear incident. For example, a bear killing livestock on three different cases is treated as a single incident. This gave more accurate correlation to the relationship of incidents to bear populations.

The number of bear incidents per year increased from 1977-87 (Figure 117). Much of this increase was due to livestock depredations during the 1985-87 period (Figure 118). This was possibly a result of increased reporting of livestock problems and

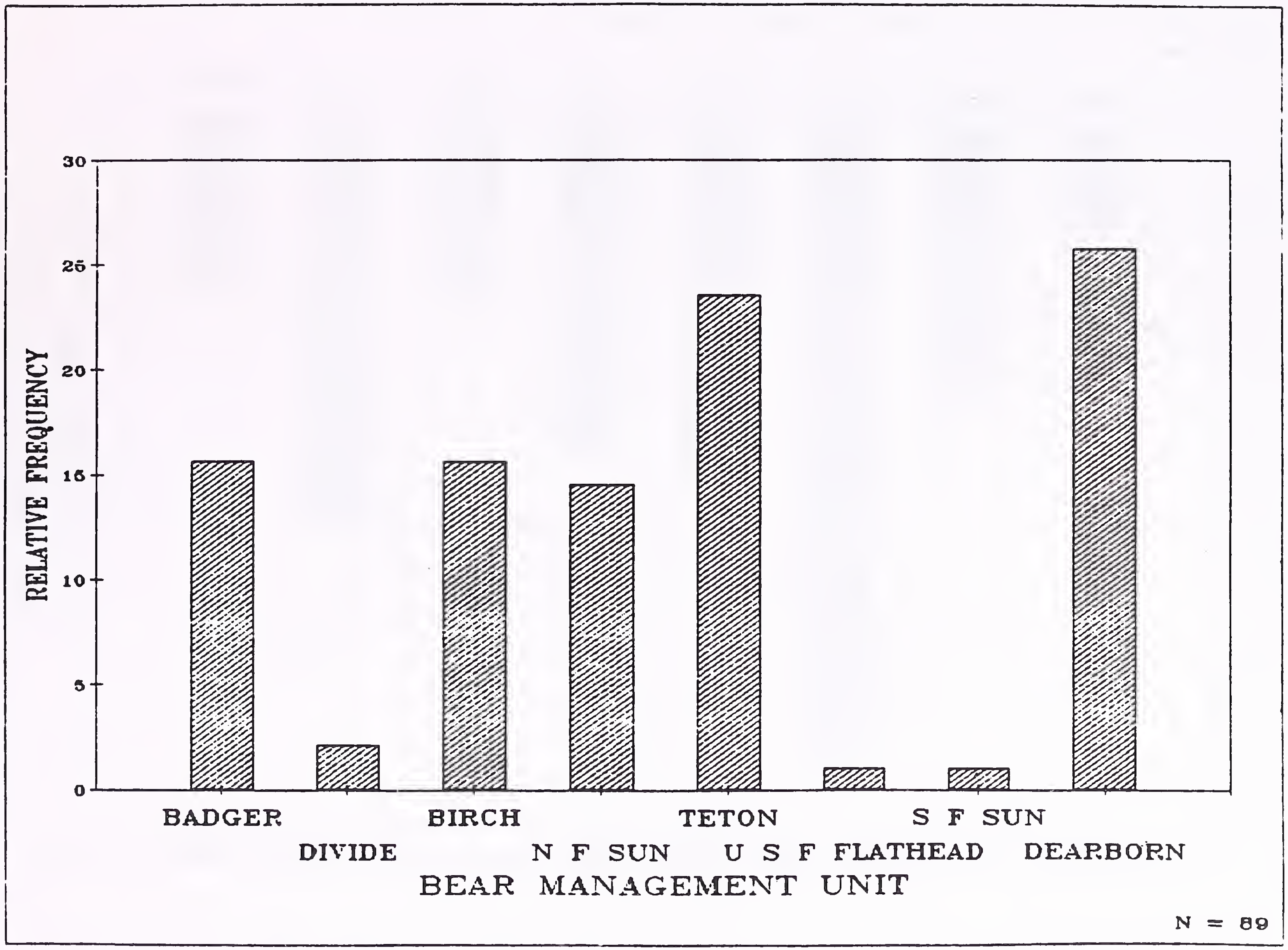


Figure 115. Problem grizzly bear incidents, by bear management unit.

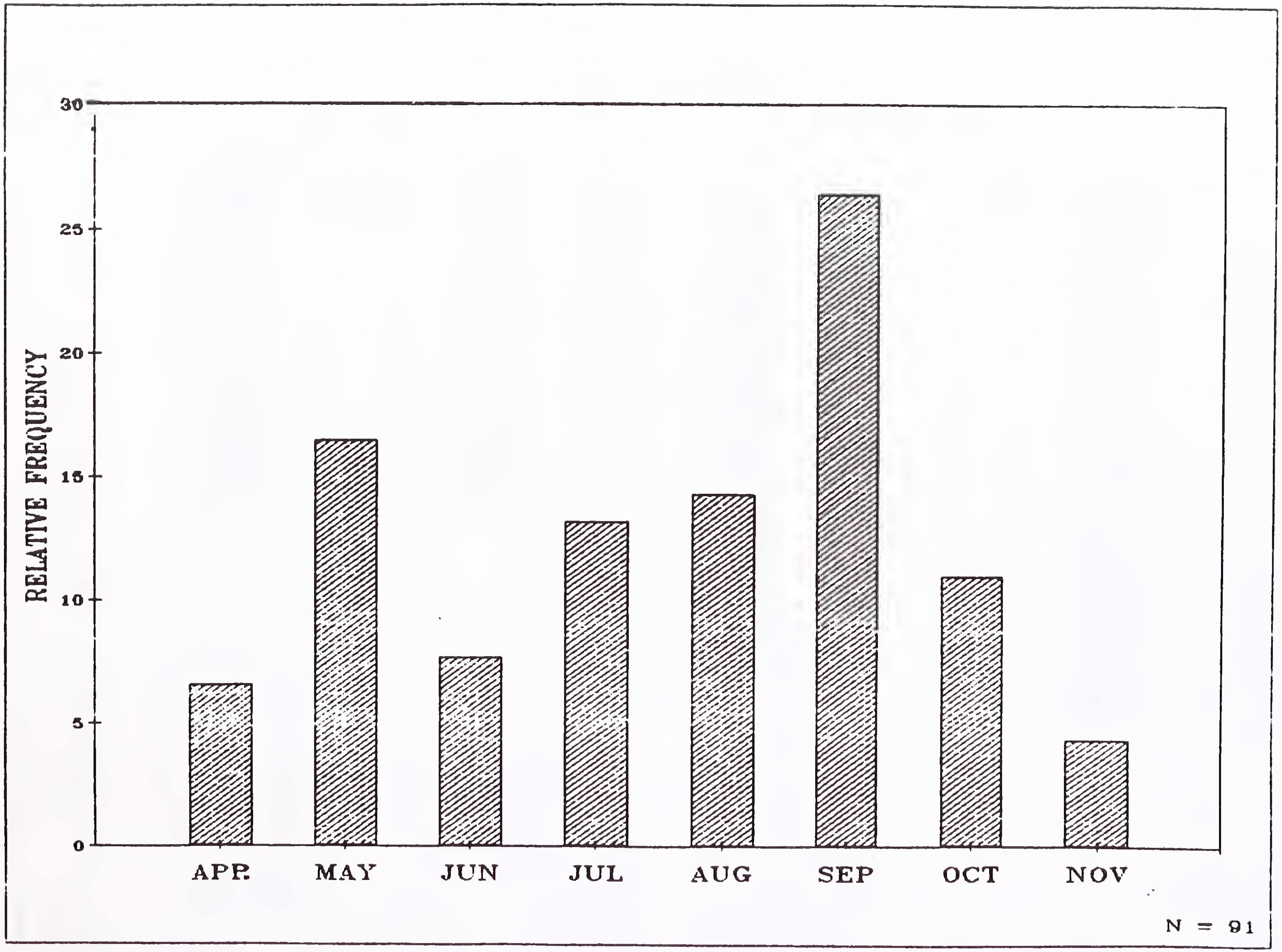


Figure 116. Problem grizzly bear incidents by month.

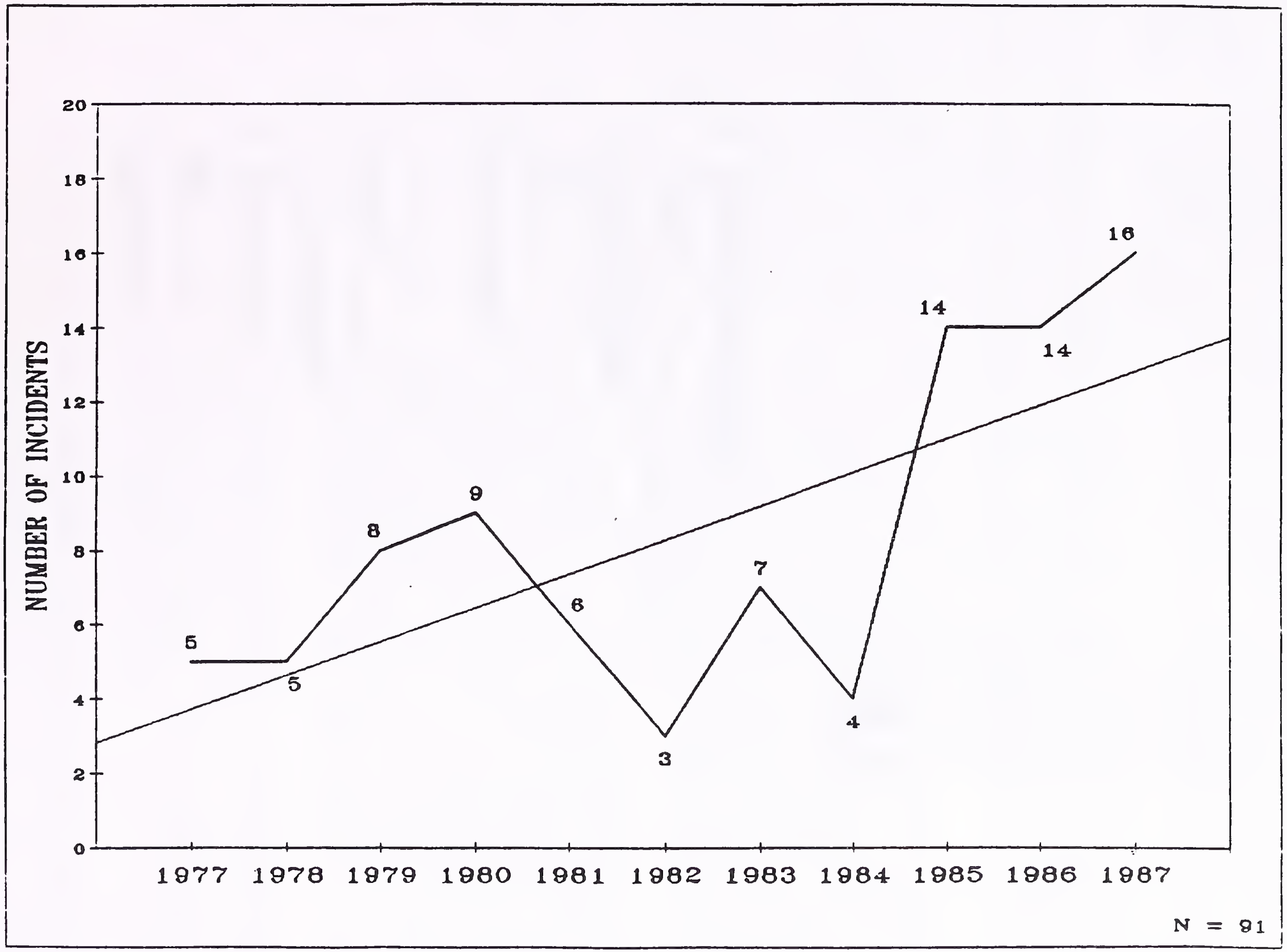


Figure 117. Problem grizzly bear incidents by year.

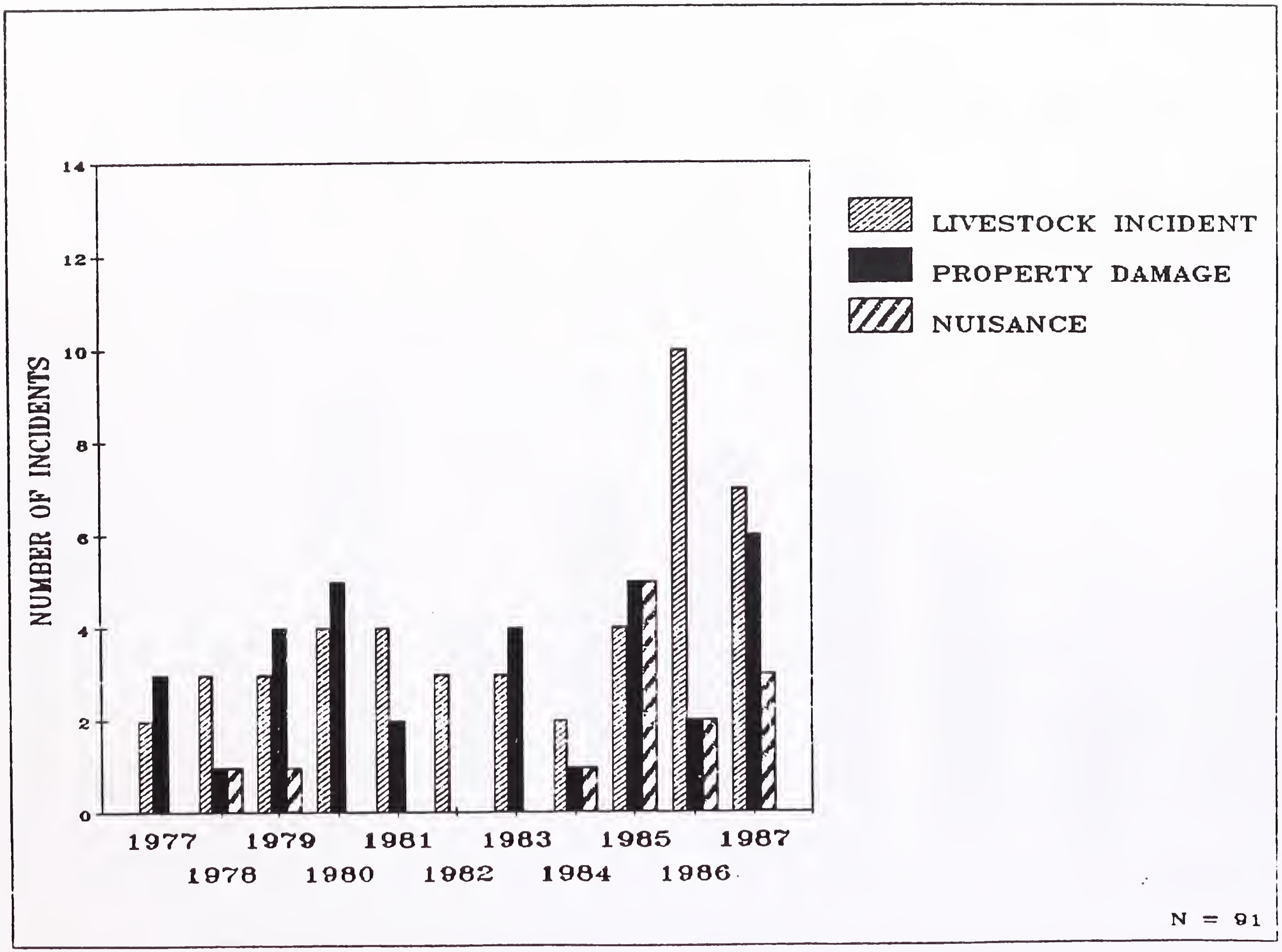


Figure 118. Categories of problem grizzly bear incidents by year.

increased stress due to drought conditions prevailing during the 1985-87 period.

Some of the increase in bear incidents was due to an increase in nuisance situations reported as well. This increase may be a result of changes in management policy, which provided a full time person along the front to handle these nuisance situations and the effects of the drought.

The increase in problem situations may also have been related to the increased cub production detected in the years 1982 and 1983. This increased production of cubs resulted in a pulse in subadults present on the area in 1985-87. The age distribution of problem bears indicates that these subadults as a group caused most of the conflicts with humans on the Rocky Mountain Front.

The fact that the Rocky Mountain Front grizzly population appeared stable during the same period implies that the conflict situations increased in response to several factors other than a sustained increase in the number of bears present. Even a substantial increase in population could not fully explain the abrupt increase in bear incidents during the period 1985-87. Bear food failures have been documented in literature and often are coincident with black bear depredations (Hatler 1967, Piekielek and Burton 1975, and Rogers 1976). In our study area the increased depredations observed were coincident with general berry crop and pine nut failures because of severe drought conditions.

We evaluated the mortality and survival rates of problem grizzly bears in the Northern Continental Divide Ecosystem using the Micromort program (Heisey and Fuller 1985). All grizzlies in or near the study area which were radio monitored following their first infractions against society were included in the analysis. This included 15 bears captured initially in a management action and five grizzly bears captured initially in research efforts then recaptured during management actions. The monitoring of bears continued after the first management action for each bear until the bear died or radio's failed. Radio monitoring efforts on all bears resulted in 1901 radio days including all sex and age classes except cubs (Table 84).

No cubs of the year were involved in monitoring of the management bears with the exception of two cubs of bear 230. This family group survived a fall season and denned together about half the distance back to their original home range. It was not known if the cubs survived the denning period and emerged with their mother to complete the journey to the Mission Range.

Twelve (60%) of the radio monitored problem grizzly bears died during the study. Two (10%) had unknown fates. We calculated a minimum mortality rate using the known mortalities and a maximum rate which assumes that the bears with unknown fates died at the end of the monitoring period. Mortalities included eight males and four females. Unknown fates included one male and one female. No mortalities were recorded during the winter periods when bears were in dens.

Table 84. The number of radio days by sex and age classes used for calculating annual mortality rates for problem grizzly bears, 1977-87.

	Spring	Summer	Fall	Winter	Total
Subadults*	211	234	339	151	935
Adults	179	86	248	453	966
Male	259	252	309	302	1122
Female	179	86	248	453	966
All bears	390	320	587	604	1901

* Subadults included yearlings but not cubs.

Annual survival rates of problem grizzly bears ranged from a minimum of .125 to .175 (Table 85). Survival rates of males was lower than females. Survival rates of subadults was lower than adults (Table 86). The sample size of radio days was insufficient to classify sex and age data further.

Table 85. Survivorship data from radio marked problem grizzly bears in the Northern Continental Divide Ecosystem, 1977-87.

	Males	Females	All bears
Spring			
Max.	.517 (.207-1.0)	1.0 (-)	.646 (.352-1.0)
Min.	.371 (.12001.0)	1.0 (-)	.519 (.246-1.0)
Summer			
Max.	.782 (.481-1.0)	.399 (.064-1.0)	.678 (.395-1.0)
Min.	.782 (.481-1.0)	.399 (.064-1.0)	.678 (.395-1.0)
Fall			
Max.	.335 (.128-.868)	.483 (.211-1.0)	.399 (.210-.752)
Min.	.335 (.128-.868)	.379 (.145-.974)	.355 (.180-.696)
Annual			
Max.	.136 (.033-.555)	.193 (.027-1.0)	.175 (.062-.490)
Min.	.097 (.021-.459)	.151 (.020-1.0)	.125 (.040-.390)

Survival rates were lowest during the fall and about equal during the spring and summer. During the fall bears are hunted within the study area. In addition, September had the greater number of problem incidents implying that bears are more likely to be involved in problems which result in mortality.

Confidence intervals were generally quite wide because of the small number of radio days in the data set. Due to the large number of mortalities in the sample, few bears survived more than 100 radio days before being killed or removed from the ecosystem.

Table 86. Survivorship data from subadult and adult age classes of radio marked problem bears in the Northern Continental Divide Ecosystem, 1977-87.

	Subadult	Adult
Spring		
Max.	.668 (.302-1.0)	.621 (.243-1.0)
Min.	.668 (.302-1.0)	.385 (.101-1.0)
Summer		
Max.	.587 (.280-1.0)	1.0 (-)
Min.	.587 (.280-1.0)	1.0 (-)
Fall		
Max.	.302 (.115-.782)	.581 (.273-1.0)
Min.	.247 (.087-.691)	.581 (.273-1.0)
Annual		
Max.	.119 (.028-.503)	.361 (.109-1.0)
Min.	.097 (.022-.433)	.224 (.049-1.0)

The causes of mortality for radio marked grizzlies included hunting, management removal and illegal mortalities (Table 87). Illegal mortality contributed the most to the overall mortality rate for problem grizzly bears. All management removals in this sample were indirectly a result of the conflict between bears and livestock.

GRIZZLY AND BLACK BEAR RELATIONSHIPS

Black bears and grizzly bears are sympatric on the Rocky Mountain Front. During this study we were able to gather information on the distribution, physical characteristics, home range, habitat use, and food habits from black bears to compare with grizzly bears. Home range and habitat use were measured from a small sample of radio collared black bears within the core area between

Deep Creek and Birch Creek (Figure 119). A specific grizzly data set for comparison was created by sorting all grizzly data by UTM coordinates which best described the composite home range of our radio collared black bears.

Table 87. Mortality rates by class of mortality for problem grizzly bears in the Northern Continental Divide, 1977-87.

Class	Maximum		Minimum	
Hunting	.076	(0-.178)	.099	(0-.225)
Illegal	.370	(.073-.667)	.446	(.136-.755)
Livestock	.244	(0-.548)	.281	(0-.616)
Unknown fate	.186	(0-.469)	---------	
Total	.875		.825	

Trapping and Radio Tracking Black Bears

From 1976-86, 139 black bears were captured during research and management actions. During the study period, 129 black bears were marked during research efforts while ten black bears were marked during management actions. An average of 12.6 bears were captured within each year.

Black bears were captured in each of the five Grizzly Bear Management Units where grizzlies were also captured. No trap efforts were conducted within the North Fork of the Sun River BMU due to its wilderness status and the emphasis of the project on nonwilderness lands. The black bear capture rate averaged 32.8 trap nites per capture and 34.4 trap nites per individual bear. The black bear capture rate, expressed in trap nites per bear, was lowest in the Sun River South BMU and highest in the Teton Birch BMU for the trapping efforts 1980-86 (Figure 120).

Black bears were captured more frequently in BMU's where grizzlies were less frequently captured (Table 88). If we assume that capture rates was determined largely by density relationship then the data suggested a negative density relationship may exist between these two species. Effort to capture a black bear was approximately one third to one fourth that required to capture a grizzly bear.

Seven black bears, including two females and five males, were fitted with radio-collars and monitored during 1981-1984. By June 1, 1984 all collars were non-functional. No further black bears were collared, and radio-monitoring was not conducted in 1985 or 1986. Preliminary results from radio-locations of collared black bears relating to home ranges, denning, food habits, and habitat use were previously presented (Aune and Brannon 1986).

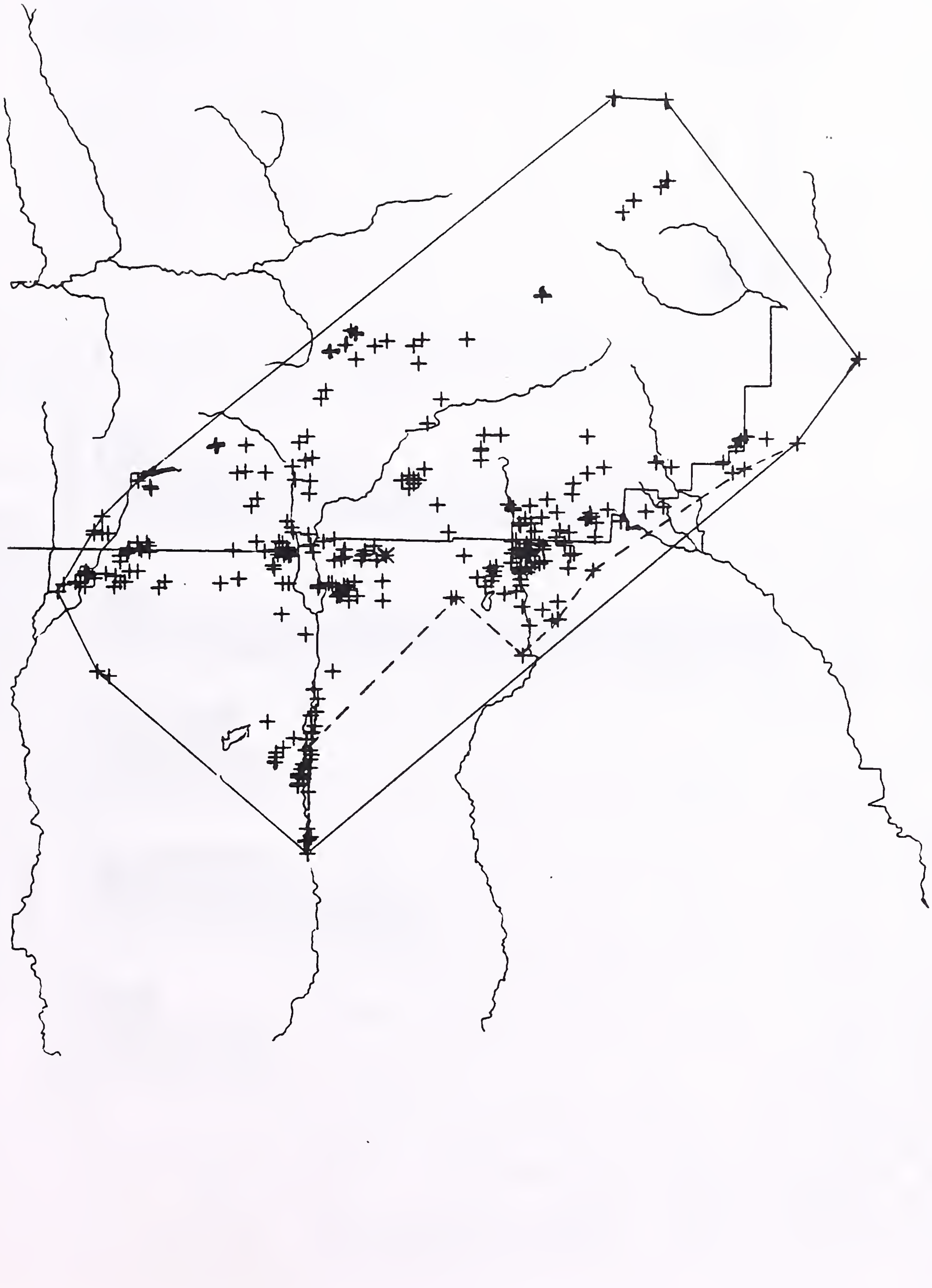


Figure 119. Composite and modified composite home range of black bears along the Rocky Mountain East Front, 1981-84.

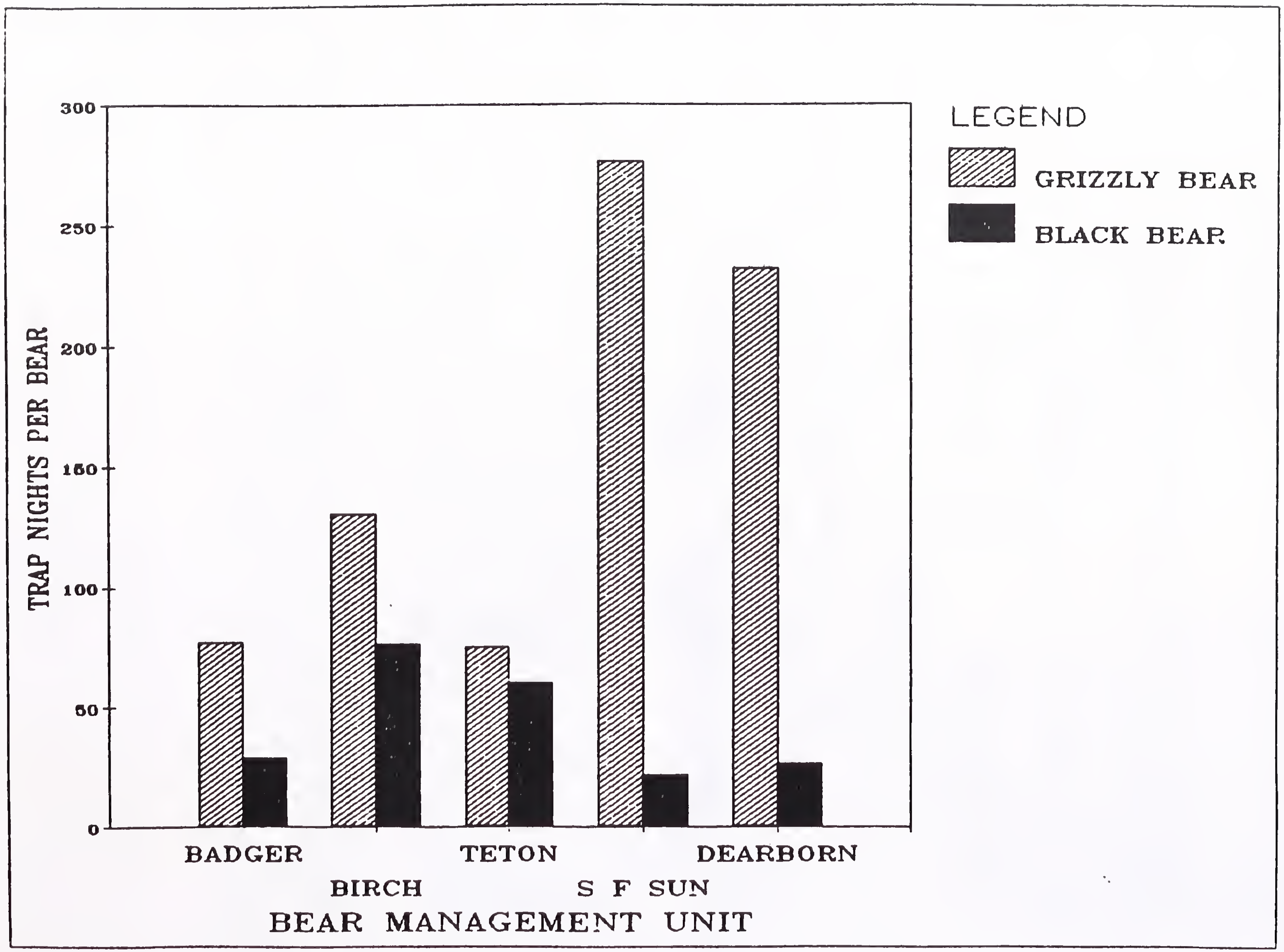


Figure 120. Capture effort by bear management unit.

Table 88. Ranking of Bear Management Units for capture rates of grizzly and black bears, 1980-86.

Bear Management Unit	Grizzly rank	Black bear rank
Badger-Two Medicine	2	3
Teton-Birch	3	5
Teton-Sun	1	4
Sun River South	5	1
Dearborn	4	2

A total of 299 black bear radio locations were recorded during the monitoring period. One hundred thirteen (37.8%) locations were obtained during spring while 100 (33.4%) and 86 (28.8%) were recorded for the summer and fall periods respectively.

Physical Characteristics

Physical measurements were recorded from 173 black bear captures from 1976-86 (Aune and Stivers 1981, 1982, 1983; Aune et al. 1984, 1986; Aune 1985). An AOV was conducted to determine if a relationship existed between female nipple length and age of first reproduction. There was a significant difference (P=0.0003, N=24) between ages in mean nipple length (Table 89). A multiple range test indicated that females older than two years had a mean nipple length greater (P=0.05) than those two years or younger.

Although the analysis we conducted only indicated a statistically significant difference in mean nipple length between two year olds or younger and those older, a biological difference was apparent at age 5.0 years. Although the data indicated that mean nipple length at age 5.0 years was 11.2 mm and at age 8.0 years was 9.7 mm, two exceptions should be noted. First, black bear 331 had not yet produced cubs at 5.0 years old when her nipple length was 9.7 mm, but at age 7.0 after producing her first litter at age 6.0, her nipple length was 16.0 mm. If we exclude her from the analysis at age 5.0 years, then the mean nipple length for age 5.0 years was 12.7 mm. Second, bear 336 was captured at 8.5 years of age without any young and a nipple length of 9.7 mm. When captured she showed no evidence of having previously suckled young. Excluding bears 331 and 336, of the remaining 22 females captured, all bears older than 5.0 years had a nipple length of at least 12.7 mm and all bears younger than 5.0 years had nipple lengths of 9.7 mm or less. Kasworm (1986) reported that a nipple length of at least 12 mm for black bears appeared to indicate previous production of young. Our analysis supports this suggestion.

Table 89. Mean teat length and diameter by age for female black bears on the Rocky Mountain East Front, 1976-1986.

Age	Length (mm)	N	Diameter (mm)	N	Observed lactation
1	3.3	1	3.3	1	No
2	4.5	5	7.7	5	No
3	9.7	1	9.7	1	No
4	9.1	3	7.5	3	No
5	11.2	2	12.8	2	No
6	15.9	2	8.0	2	Yes
7	15.9	3	9.7	3	No
8	9.7	1	9.7	1	No
9	12.7	1	9.7	1	Yes
12	12.7	1	6.4	1	No
13	12.7	2	9.5	2	Yes
16	16.0	1	9.7	1	No
20	25.1	1	12.7	1	Yes

Using data from black bear captures (Aune and Stivers 1981, 1982, 1983; Aune et al. 1984, 1986; Aune 1985) we derived equations for predicting body weight for males, females and both sexes combined. We used three regressions for predicting weight, the first a log^{10} -log^{10} regression of chest girth and weight, the second a regression of a body index (body length times chest girth squared) and weight (McLellan 1982), and the third an exponential expression of chest girth. The fit (as determined by the coefficient of determination) varies with the regression used and the sex class (Table 90). The best fit for males (r^2=.924) was the regression of the body index. The best fit for females (r^2=0.924) was the log regression of chest and weight.

These analysis indicate that it may be possible to estimate body weight using these equations when scale weight is not possible or is impractical to obtain. Relationships between chest girth and body weight have been reported for all species of North American bears (Payne 1976, LeCount 1977, Stirling et al. 1977, Glenn 1980, Kingsley et al. 1983, Nagy et al. 1984, Waddell and Brown 1984, Swenson et al 1987).

A weight estimate was made for each of the 173 captures which provided adequate data for predictions. The body index equation was used to make weight predictions for all males. The log^{10}-log^{10} chest girth and weight equation was used for females.

The AOV of weight estimates indicated a significant difference (P<0.05) in weight estimates for males and females between similar ages. Average weight estimates was larger in each age class for males than for females (Table 91). The largest weight estimate for males was 130.9 kg. and for females 81.4 kg.

Table 90. Equations for predicting live weights of black bears on the Rocky Mountain East Front.

Sex	Equation	r^2	N
All bears	$W=0.0022+10.68(I)$	0.924	82
	$W=0.0370(G)^{2.379}$	0.909	82
	$W=\exp(2.430+0.077(G))$	0.894	82
Males	$W=0.0021+15.48(I)$	0.924	60
	$W=0.0516(G)^{2.289}$	0.921	60
	$W=\exp(2.579+0.073(G))$	0.911	60
Females	$W=0.0021+10.33(I)$	0.826	22
	$W=0.0233(G)^{2.497}$	0.850	22
	$W=\exp(1.899+0.094(G))$	0.818	22

W=Body weight, I=Body index (body length times chest girth squared), G=Chest girth.

Growth curves were derived from weight estimates for males and females (Figure 121). Average weight gains per year for males and females ages cub to five were 10.0 kg. and 6.6 kg. Average weight gains for males and females aged six to ten years was 4.8 kg. and 0.8 kg. Females do not appear to gain significant weight after reaching reproductive age whereas males continue to increase in weight until a more advanced age.

Table 91. Weight estimates (kg.) for male and female black bears by age on the Rocky Mountain Front.

	Males			Females		
Age	N	Avg.	Range	N	Avg.	Range
Cub	1	21.8	-	1	16.4	-
1	5	26.7	23.2- 31.8	2	17.5	16.4-18.6
2	24	41.6	26.4- 63.2	7	37.4	25.9-49.5
3	23	51.8	30.9-102.3	5	45.2	36.4-60.9
4	14	71.9	53.6- 92.7	5	47.9	39.5-58.2
5	11	84.1	63.6-121.4	2	49.3	43.6-55.0
6	6	86.5	55.9-104.1	4	59.5	47.3-81.4
7	6	87.4	77.7-103.2	4	53.2	39.1-68.2
8	5	104.4	93.2-124.1	2	49.8	44.5-55.0
9	9	103.7	78.6-133.6	2	61.4	57.3-65.5
10+	15	105.8	53.6-130.9	8	62.7	53.6-70.5

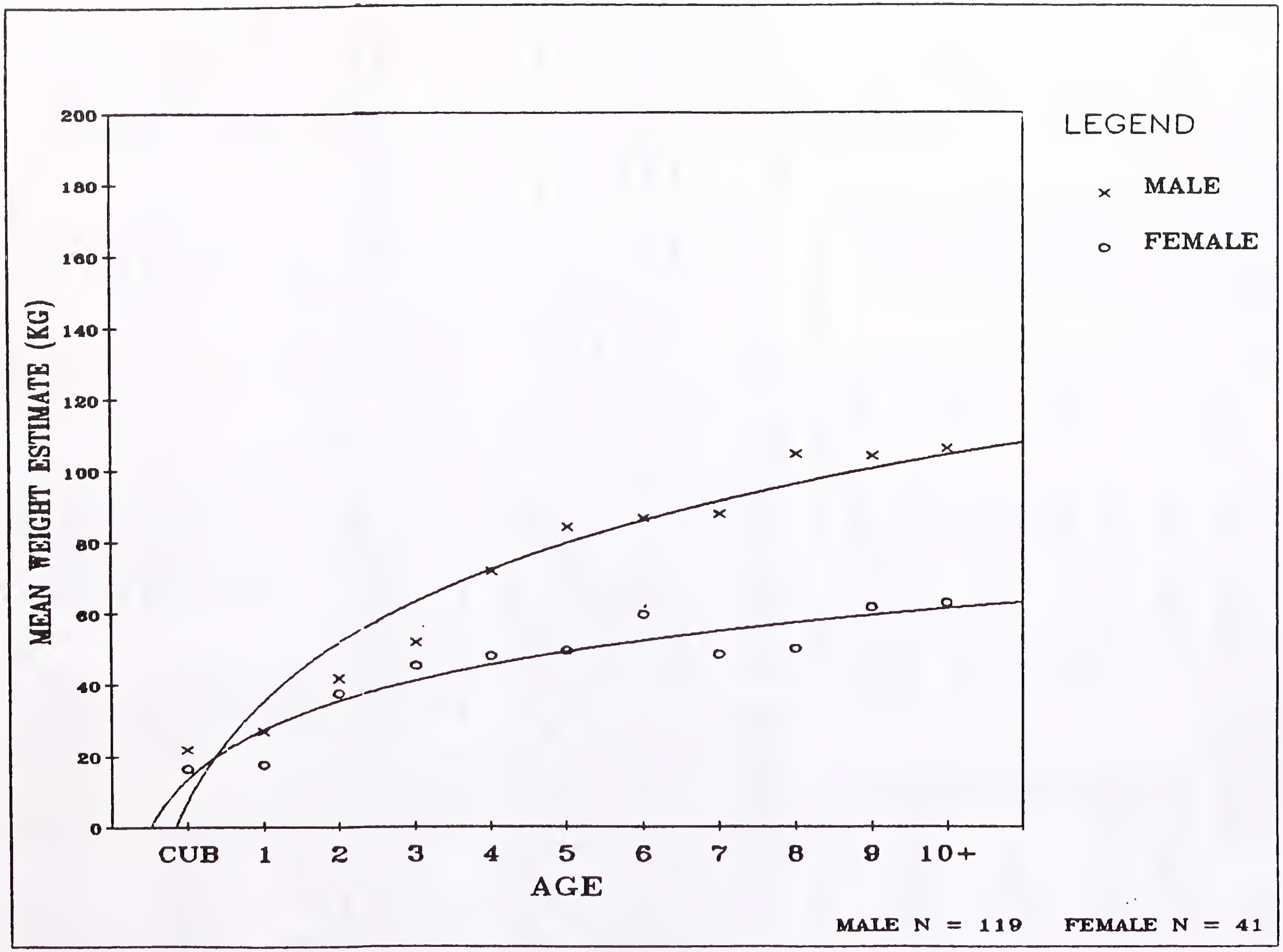


Figure 121. Black bear mean weight.

An AOV by age was used to determine if testes length or width, or baculum length could be used to estimate sexual maturity in males. The results indicated that a significant difference existed for mean testes length (P=0.0001, N=117), mean testes width (P=0.0001, N=117), and mean baculum length (P=0.0001, N=116), but a multiple range test failed to reveal any biological significance for these measurements in determining sexual maturity. Plots of these mean measurements (Figure 122), however, indicated that they may be useful as a measure of growth.

A comparison of neck circumference, zoological length, and chest girth between sexes was conducted. Log regressions by age class reveal, very insignificant differences between the sexes for zoological length (Figure 123). It appears that chest girths of males may be slightly larger than females after age two (Figure 124). The neck circumference of males was only slightly larger than females of similar ages for bears beyond age two (Figure 125). Chest girth was the most significant sexually dimorphic characteristic for black bears.

Physical data analysis for black bears compared closely with those discussed previously in this report for grizzly bears. The teat length indicated prior reproduction for female grizzly bears and black bears at a similar size and age. Other body measurements showed similar relationships as growth parameters for grizzly bears as well.

Sexual dimorphism was evident in weight, chest girth, and to a lesser extent neck circumference but not in zoological length for both species. Sexual dimorphism in black bears was evident after age one. In grizzlies it did not become evident until after age two.

Pelage coloration in black bears were variable from complete black to a blonde or yellow color. The majority of bears were black in color (Table 92). There was no difference in proportions between the sexes. The proportion of brown and black phase bears in this study were similar to those reported for the South Fork of the Flathead (Jonkel et al 1978). In Alberta, Nagy and Russell (1978) found 90% of their black bears were of the black phase. In the North Fork of the Flathead Jonkel, et al (1978) reported 75% were black. In the Cabinet-Yaak region of Montana, Kasworm and Manley (1988) report 60% black phase and 40% brown phase bears.

Table 92. Percent of pelage colorations in black bears from the Rocky Mountain Front, 1976-87.

	N	Black	Brown	Blonde
Males	98	52.0	45.9	2.1
Females	36	58.3	36.1	5.5
Total	134	53.7	43.3	3.0

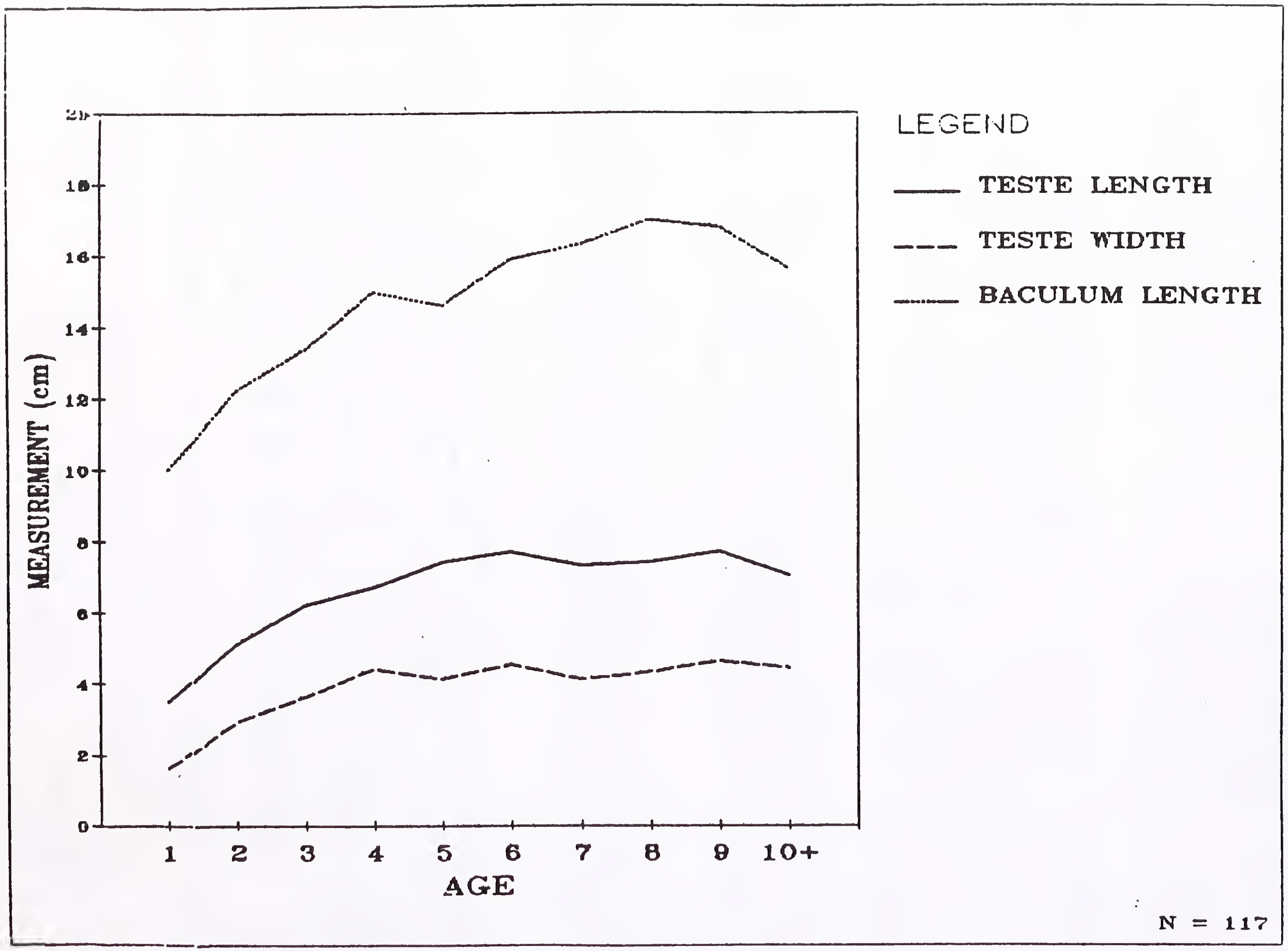


Figure 122. Black bear physical measurements.

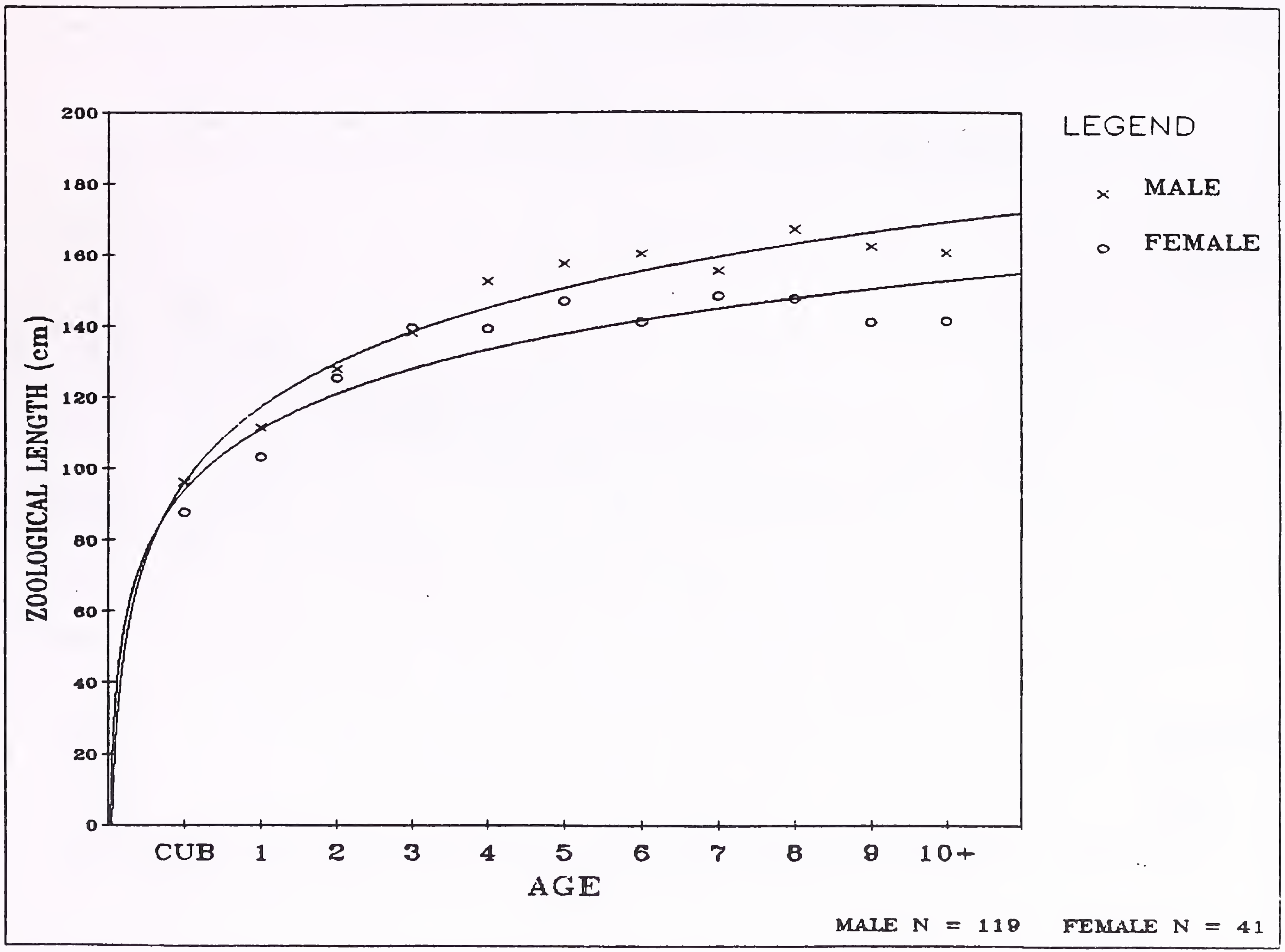


Figure 123. Black bear mean zoological length.

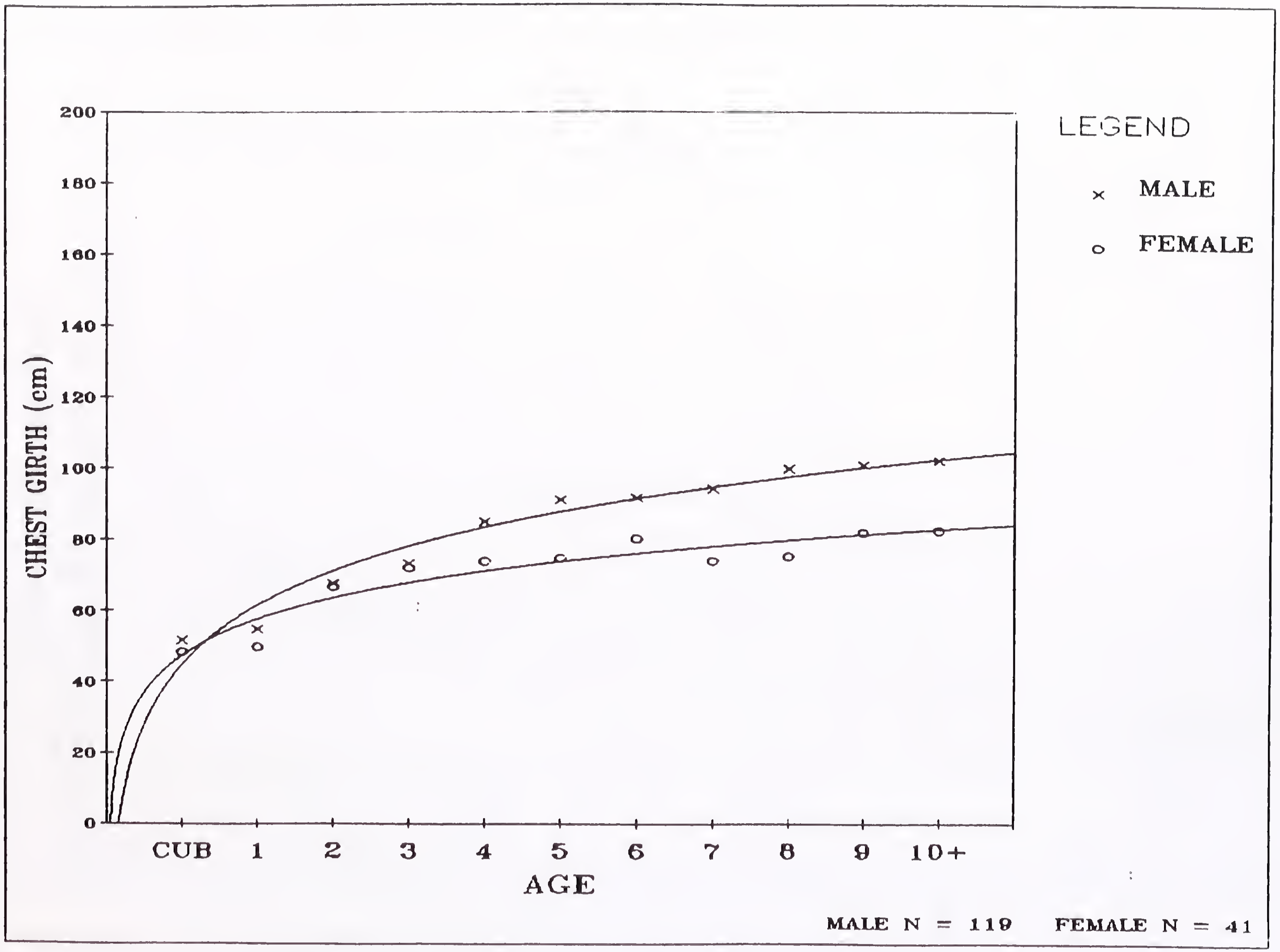


Figure 124. Black bear mean chest girth.

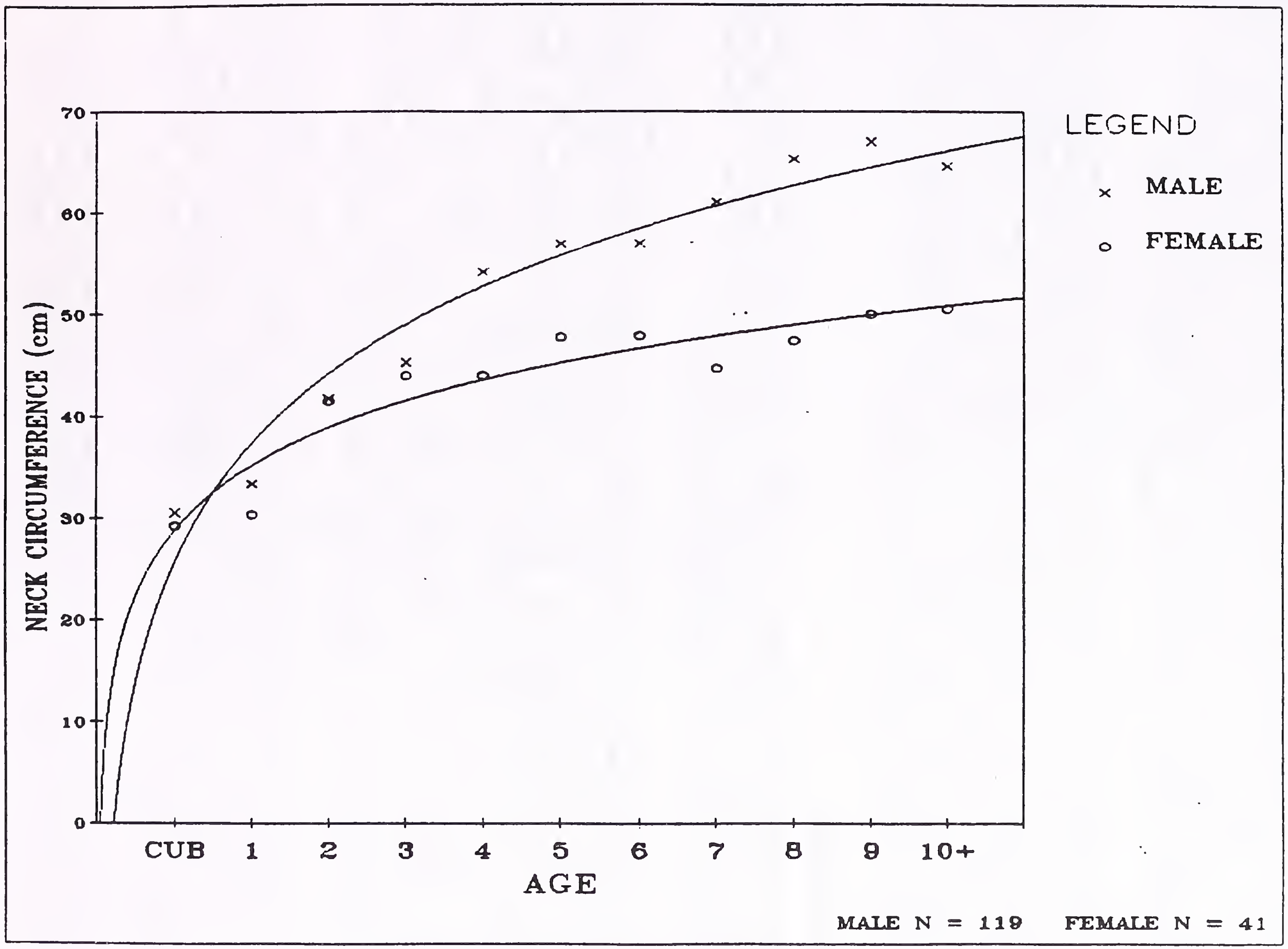


Figure 125. Black bear mean neck circumference.

Distribution, 1976-1986

A total of 1,226 black bear observations have been recorded along the entire Rocky Mountain Front during the study. Eighty percent of the observations were from the northern portion of the study area. Maps of black bear distribution on the core area were developed from radio-locations, trapping, sightings, and bear sign collected during 1976-1986 so that comparisons could be made between distributions of black bears and grizzly bears.

It was apparent from these maps that these two species had similar distributions with the exception of the lowland riparian areas (compare Figure 10 and Figure 126). Black bears were more strictly confined to the forested mountain areas and less frequently were observed in the lowland regions of the study area. Grizzly bears were more frequently observed utilizing habitats well out onto the plains away from the mountain front. Concentration areas were similar between species with the exception of high peak areas where grizzly bears dug roots in the alpine.

Home Ranges

Home ranges were mapped for seven black bears monitored between 1981 and 1984. Black bear 288, an adult male cast his collar in August 1982 only three months after being instrumented. Therefore, his home range was probably underestimated.

The minimum home range area for adult males in this study (Table 93) was considerably larger than in the Cabinet Mountains, Montana (76.9 k^2, Kasworm 1986) and the East Boulder River, Montana (152 km^2, Rosgaard and Simmons 1982). Adult female home range area was also considerably larger in this study than reported by Kasworm (1986) (17.4 km^2) or by Rosgaard and Simmons (1982) (6.5-35.2 km^2). Home range sizes for both sexes are larger in the present study than for other populations in North America (Table 94). Amstrup and Beecham (1976) suggested that the quality, quantity and distribution of food, as influenced by climate and topography, probably determine home range size. On the east front the climate is more arid than in many other areas of North America.

Another factor determining home range size of black bears could be interaction between grizzly and black bears. The influence of grizzlies on black bear home ranges is not known and no literature is available to support the hypothesis of grizzly influence on black bear home ranges. Observations indicated, however, that black bears can be displaced from feeding areas by grizzlies (Kendall 1984).

Grizzly and black bear home ranges overlapped considerably on the Rocky Mountain Front. Female grizzly bear minimum home ranges were four to five times larger than the average female black bear

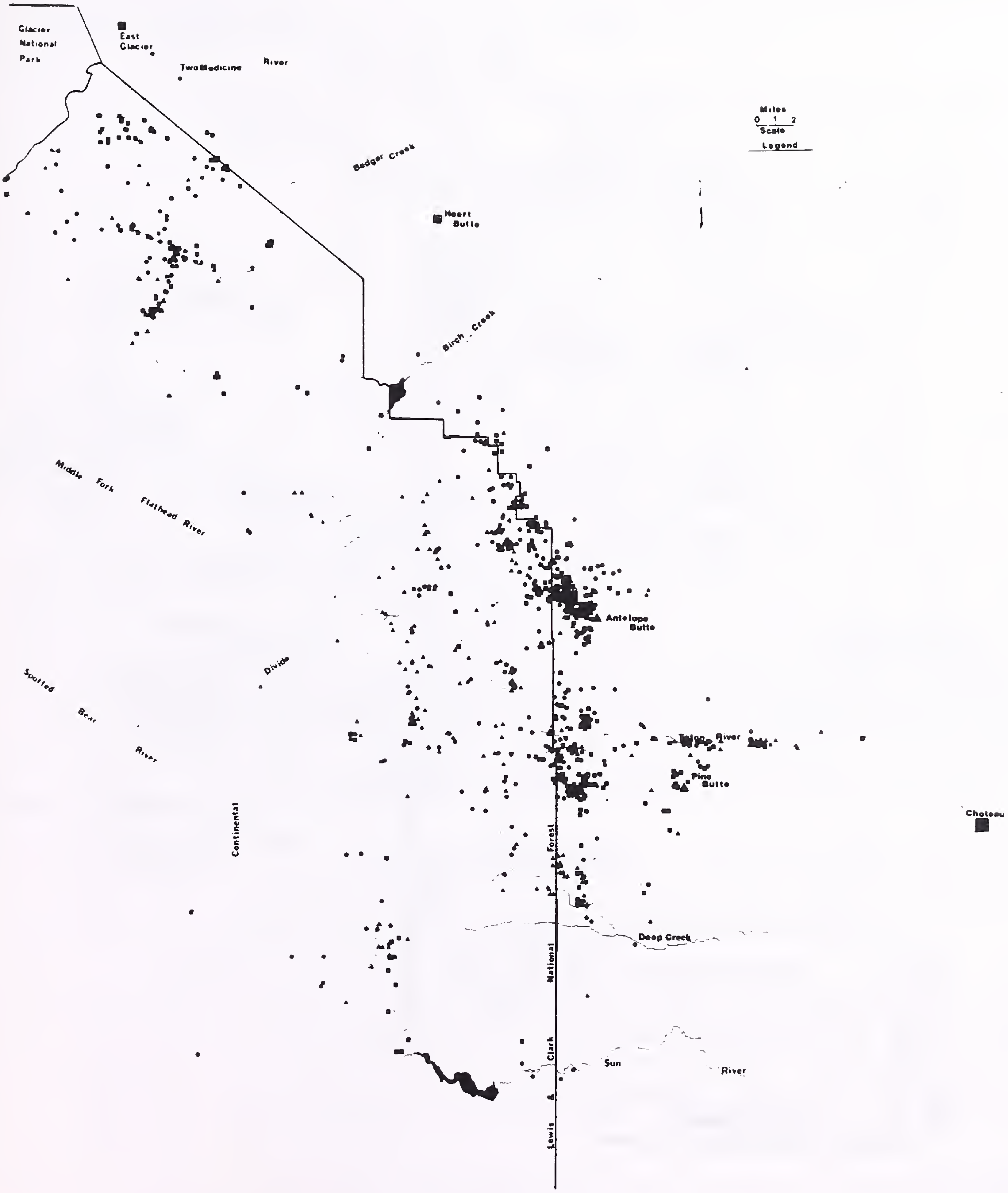


Figure 126. Black bear distribution 1976-86, for the Rocky Mountain Front study area north of the Sun River.

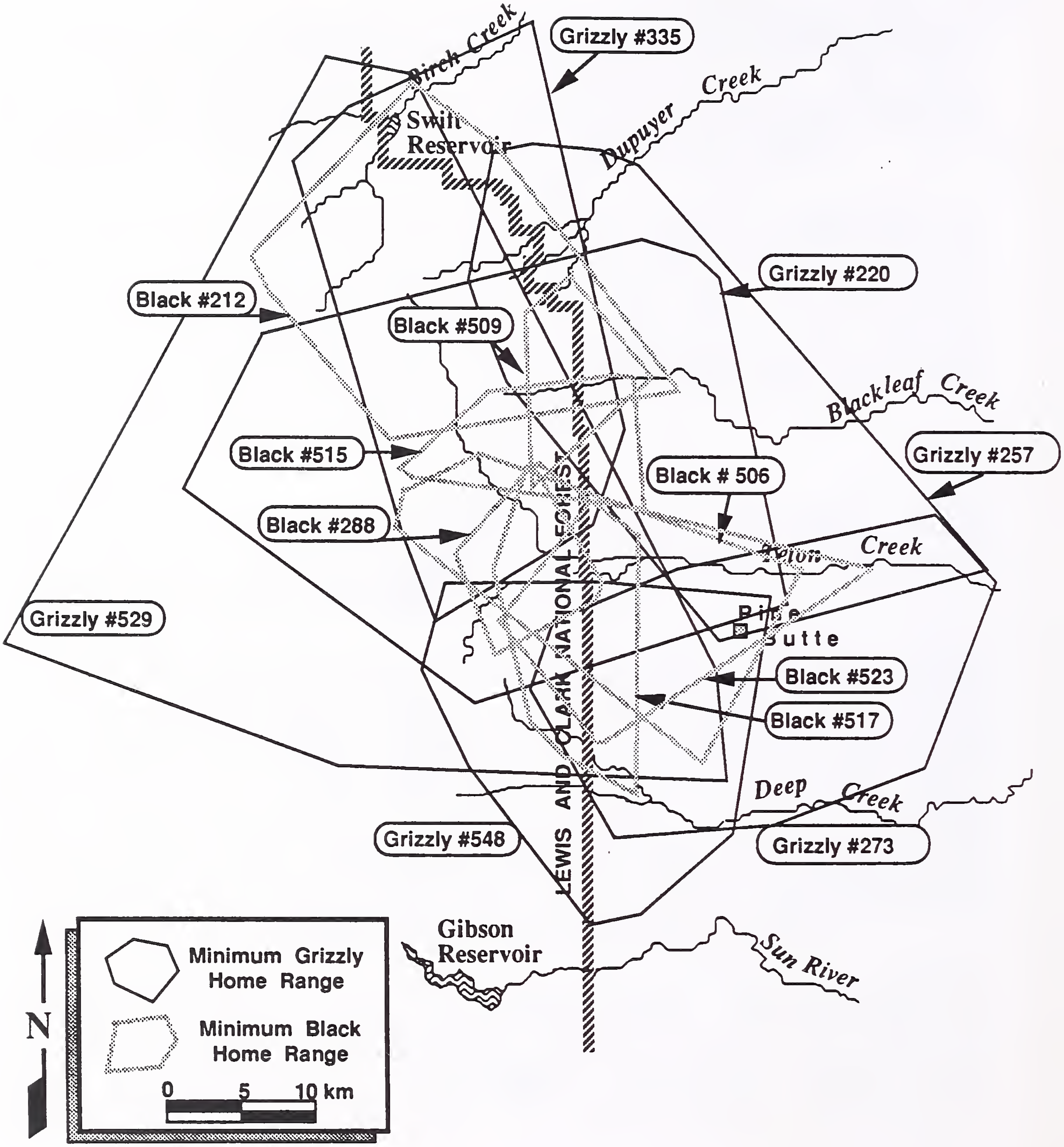


Figure 127. Grizzy and black bear home range overlap on the Rocky Mountain Front, 1981-84.

minimum home range. Male grizzly home ranges were five to eight times larger than male black bear ranges.

Table 93. Home range areas for black bears on the Rocky Mountain East Front, 1981-84.

		Home Range Area (km^2)			
Bear No.	Sex	Age (1986)	Minimum	Modified minimum	Number of locations
212	M	7.5[1]	379.8	96.4	34
288	M	17.5	239.3	62.7	12
506	M	5.5[1]	268.2	86.9	36
509	F	15.5	69.3	32.1	79
515	M	6.51	92.8	19.3	27
517	M	7.51	143.9	92.6	62
523	F	10.5	205.3	40.2	80
Mean (N=5)	M		224.8	71.6	158
Mean (N=2)	F		137.3	36.2	149
Composite (N=7)			1136.1	714.4	330

[1] Age at death (See Appendix D).

Den Studies

A total of 14 black bear dens have been located within the study area. Nine of these dens were examined from the ground. All of the inspected dens were dug. Black bear dens ranged in elevation from 1368 to 2267 m. for an average of 1716 m. Slopes of den sites ranged from five to 70% and averaged 32.6%. Black bear dens were found in 11 different habitat types and seven different land types.

We compared data between these 14 dens in the core area with 34 grizzly bear dens within a similar region. Grizzly and black bear dens were located on similar aspects, (Figure 128) however, grizzly bear dens were significantly higher in elevation and on steeper slopes than black bear dens (Table 95).

Black bears entered dens from October 13 to November 30 and emerged from dens March 20 to May 5. Median date for den entrance for black bears was November 10 (N=8) which was not much different from the Median date of November 7 (N=45) for grizzly bears. The median date for den emergence for black bears was April 4 (N=8) which is also not significantly different than the median April 7 (N=43) emergence date for grizzlies.

Black and grizzly bear denning habitat was primarily differentiated by elevation. Grizzly bear dens were found at high elevations along the front range while black bear dens were from mid-elevations to the riparian areas of the prairie. The overlap of

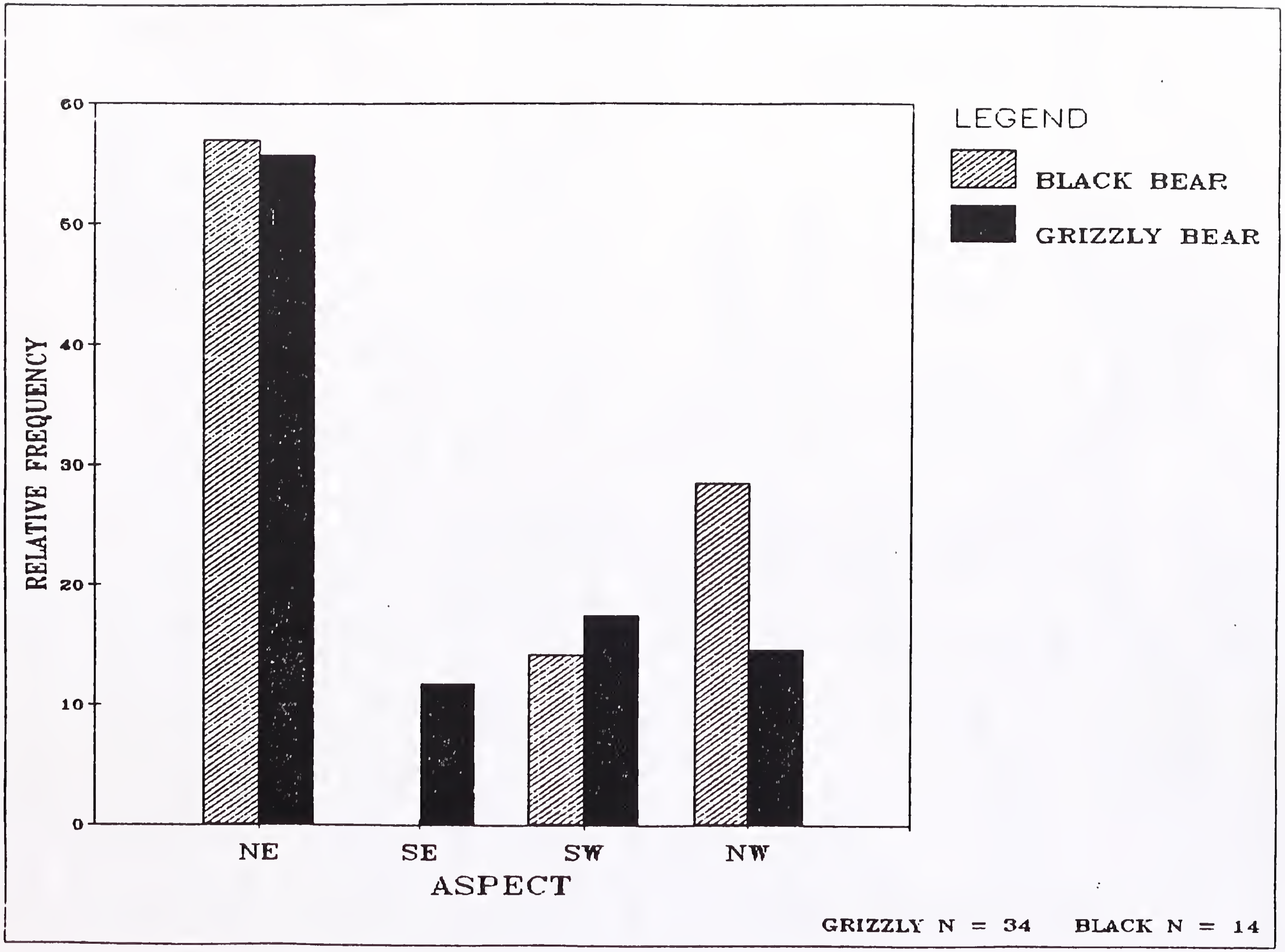


Figure 128. Aspect of black bear and grizzly bear dens.

grizzly and black bear denning habitat may be more prevalent in other areas of western Montana where grizzly bears were known to den at lower elevations.

Table 94. Mean home range areas for black bears in North America.[1]

Study location	Home Range Area (km^2) Adult[b] Male	Female	Reference
Alaska	(79-100)[c]	(10-30)[c]	Modafferi (1982)
Alaska	153 (4-611)[d]	117[d]	Miller and McAllister (1982:98)
Alaska	141 (41-341)	21 (4-46)	Schwartz et. al. (1983)
Arizona	29 (15-69)	18 (10-30)	LeCount (1977)
Idaho	105 (61-156)	18 (12-26)	Reynolds and Beecham (1977)
Idaho	112 (109-115)	49 (16-130)	Amstrup and Beecham (1976)
Washington	5 (2-13)	2 (1-4)	Lindzey (Island) (1976:39)
Washington (mainland)	61 (13-87)	5 (3-6)	Poelker and Hartwell (1973:72)

[a] Adopted from Schwartz et al. (1983) page 77.
[b] Age greater than 3 years-old.
[c] Includes all age classes.
[d] Includes all bears greater than 2 years old.

Table 95. Comparisons of slope and elevation between black bear dens (N=14) and grizzly bear dens (N=34) in a similar portion of the Rocky Mountain Front.

Species	Mean elevation	95 % C.I.	Mean slope	95 % C.I.
Black	1715.5	1632.7-1798.4	28.8	19.9-37.7
Grizzly	2166.7	2113.6-2219.9	56.7	51.0-62.4

Black Bear Food Habits

A total of 276 black bear scats were analyzed to determine black bear food habits (Table 96). Black bear scats contained food items from 11 major taxonomic groups including; mammals, insects, birds, tree's (pine nuts), sporophytes, forbs, roots, graminoids, shrubs (fruit), garbage and other (debris). Graminoids, forbs, and insects were the most common bear foods along the east front and these foods had high percent frequency values. In contrast seasonally important or less common foods such as fruits, mammals, sporophytes, and Pine nuts had low percent frequency values. Graminoids, forbs, and fruit had the highest percent volume of all bear food taxon.

Domestic cattle and deer were the most common mammals eaten, as indicated by both frequency and volume. Other large herbivores in the scats of black bears were domestic sheep and elk. Insects and birds were present in black bear diets also. The major insect eaten was ants. As with grizzlies, bird parts were infrequently found in scats and then most often during nesting season. Tardell and Doerr (1982) reported black bear depredations on bluebird nest boxes. Bluebird nest boxes and many ground nests of bird species are available to black bears along the Eastern Rocky Mountain Front.

In the vegetation eaten by black bears item parts selected varied with species. Berries and leaf parts were common items in shrub food species. Graminoids were primarily composed of stem or leafy parts. The forbs in black bear diets were mostly upper plant parts including leaf, stem, flowers, seeds, and fruit. Very little root matter was detected in analysis of black bear scats.

Seasonal comparisons between black and grizzly bears along the Rocky Mountain Front reveal major similarities and minor differences in the food habits (Figure 129). Grizzly bears and black bears utilized graminoids, forbs, and shrubs about equally. Black bears did show a more significant use of forbs throughout the summer and fall whereas grizzlies reduced consumption of forbs after mid summer. Grizzly bears dug roots while black bears did not. Both species fed on berries and pine nuts during the fall. Insects had higher importance values for black bears than grizzly bears for all seasons. Grizzly bears had consistently higher percent importance values for mammals in all seasons.

The species of graminoids in grizzly and black bear diets were similar with wet site species including a mix of grass and sedge being most important. Forbs utilized by both species were similar also, including such moist site species such as Angelica, Taraxacum, Lathyrus, Osmorhiza, and Heracleum. The fruits of shrub species utilized by both black and grizzly bears included; Prunus, Amelanchier, Shepherdia, and Arctostaphylos.

Grizzly bears may prey upon black bears. No observations of grizzlies killing black bears were made. However, black bear hair was found in scats. Aune and Mace (Unpublished data) reported a black bear probably killed and eaten by a male grizzly bear on the

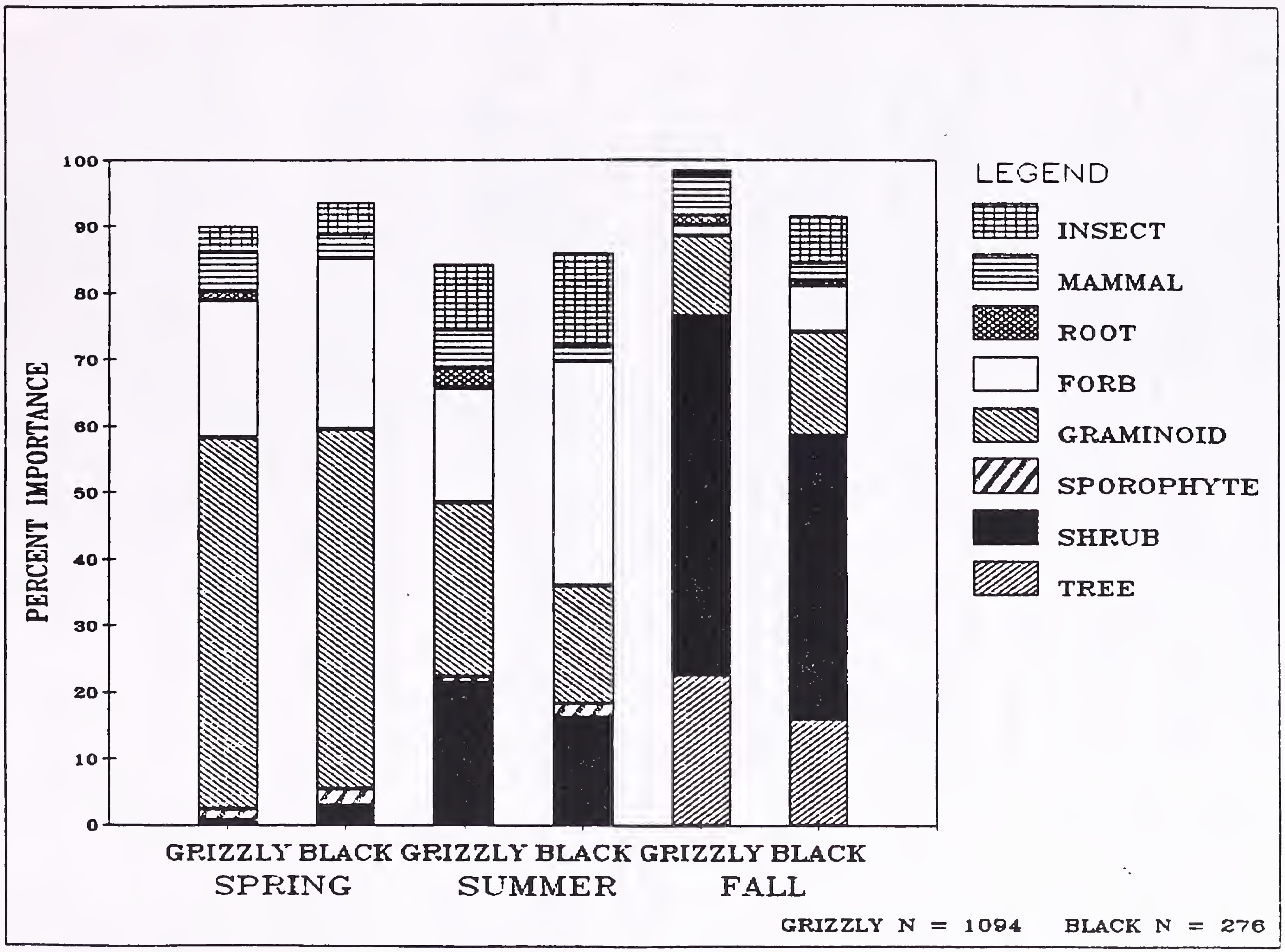


Figure 129. Black bear and grizzly bear seasonal food habits.

South Fork of the Flathead River. Grizzly bear hair was not detected in scats of black bears.

Black bear and grizzly bear diets along the Rocky Mountain Front were very similar. The differences noted were probably related to the different habitats each species can exploit and the interspecific competition between these species. Grizzly bears are more capable root diggers and can exploit sidehill parks and alpine habitat to a greater extent. Grizzly bears also may out compete black bears for carrion and are better predators than black bears thus the difference in the mammal portions of diets.

Habitat Use by Grizzly and Black Bears

Black bears were located at sites within the mid range of elevations more frequently than grizzly bears (Figure 130). Grizzly bears ranged over a broader spectrum of elevations and appeared to dominate in the low and upper elevational range.

The slopes used by these two species confirms the dominance of grizzly bears in low and upper elevational ranges (Figure 131). Grizzlies were more commonly found on lower slopes and steeper slopes while black bears were more frequently located in the mid slope range.

Both species exploited similar aspects with the exception that grizzlies dominated the lower slopes and flatlands with no discernable aspect (Figure 132).

We conducted a use/availability analysis in the core area to compare habitat preferences of these two species. Some differences were noted in habitat component preference between these species (Table 97). Black bears were concentrating use within the timbered components while grizzlies were dominant in the riparian communities.

Black bears used the rock/talus/scree, prairie grasslands, riparian shrub and riparian complex habitat component significantly less than grizzly bears (Table 98). They used the closed timber habitat component significantly more than grizzly bears. All other components were used in similar proportions.

Black bears and grizzly bears used similar habitat along the Rocky Mountain Front. There did appear to be some niche separation between these two species. Black bears were concentrating their use in habitats which were mostly timbered at middle elevations and slopes. Grizzly bears were able to exploit a broader range of elevations and more open habitat. They dominated the lower elevation riparian components and the alpine environments. Herrerro (1978, 1979) noted that while these two species coexisted in some forest ecosystems, the grizzly is better adapted for exploiting more open habitat. Our study supports this hypothesis.

Table 96. Food habits of black bears along the east front, 1978-1987.

Item	Freq.	%Freq.	Vol.	%Vol.	%Comp.	Impt	%Impt
** Mammal							
Large mammal-unident	5	1.81	171	0.62	34.20	0.011	0.06
Elk	1	0.36	40	0.14	40.00	0.001	0.01
Sheep-domestic	2	0.72	40	0.14	20.00	0.001	0.01
Microtus	1	0.36	70	0.25	70.00	0.001	0.01
Deer	17	6.16	517	1.87	30.41	0.115	0.62
Domestic cattle	13	4.71	575	2.08	44.23	0.098	0.53
Lagomorph	2	0.72	190	0.69	95.00	0.005	0.03
Small mammal-unid	2	0.72	100	0.36	50.00	0.003	0.02
Spermophilus-citellus	6	2.17	164	0.59	27.33	0.013	0.07
Microtinae	1	0.36	30	0.11	30.00	0.000	0.00
Total mammal	48	17.39	1897	6.87	39.52	1.195	3.42
** Insect							
Ant	106	38.41	1726	6.25	16.28	2.402	12.96
Bee	1	0.36	100	0.36	100.00	0.001	0.01
Moths	6	2.17	225	0.82	37.50	0.018	0.10
Coleoptera	2	0.72	15	0.05	7.50	0.000	0.00
Total insect	114	41.30	2066	7.49	18.12	3.092	8.85
** Bird							
Unidentified bird	4	1.45	12	0.04	3.00	0.001	0.01
Total bird	4	1.45	12	0.04	3.00	0.001	0.00
** Garbage							
Plastic	1	0.36	20	0.07	20.00	0.000	0.00
Total garbage	1	0.36	20	0.07	20.00	0.000	0.00
** Other							
Debris	66	23.91	1536	5.57	23.27	1.331	7.18
Wood	13	4.71	124	0.45	9.54	0.021	0.11
T-bait	4	1.45	130	0.47	32.50	0.007	0.04
Dirt	29	10.51	534	1.93	18.41	0.203	1.10
Rocks	9	3.26	77	0.28	8.56	0.009	0.05
Needles	3	1.09	125	0.45	41.67	0.005	0.03
Total other	104	37.68	2526	9.15	24.29	3.449	9.87
** Tree							
Pinus albicaulis	11	3.99	928	3.36	84.36	0.134	0.72
Pinus	1	0.36	100	0.36	100.00	0.001	0.01
Total tree	12	4.35	1028	3.72	85.67	0.162	0.46
** Shrub							
Arctostaphylos	16	5.80	887	3.21	55.44	0.186	1.00
Rosa	2	0.72	16	0.06	8.00	0.000	0.00
Amelanchier alnifolia	8	2.90	760	2.75	95.00	0.080	0.43
Prunus virginiana	6	2.17	455	1.65	75.83	0.036	0.19
Shepherdia canadensis	25	9.06	1310	4.75	52.40	0.430	2.32
Arctostaphylos uva-ursi	15	5.43	820	2.97	54.67	0.161	0.87
Total shrub	69	25.00	4248	15.39	61.57	3.848	11.02

Item	Freq.	%Freq.	Vol.	%Vol.	%Comp.	Impt	%Impt
** Sporophyte							
Equisetum	31	11.23	1634	5.92	52.71	0.665	3.59
Lycopodium	1	0.36	20	0.07	20.00	0.000	0.00
Total sporophyte	32	11.59	1654	5.99	51.69	0.695	1.99
** Graminoid							
Graminoid-unident	2	0.72	30	0.11	15.00	0.001	0.01
Avena	1	0.36	10	0.04	10.00	0.000	0.00
Bromus	2	0.72	30	0.11	15.00	0.001	0.01
Carex	2	0.72	20	0.07	10.00	0.001	0.01
Festuca	1	0.36	10	0.04	10.00	0.000	0.00
Poa	7	2.54	325	1.18	46.43	0.030	0.16
Grass/sedge	127	46.01	6314	22.88	49.72	10.527	56.82
Avena sativa	2	0.72	170	0.62	85.00	0.004	0.02
Total graminoid	142	51.45	6909	25.03	48.65	12.879	36.87
** Forb							
Forb	20	7.25	504	1.83	25.20	0.132	0.71
Angelica	4	1.45	200	0.72	50.00	0.011	0.06
Cirsium	2	0.72	160	0.58	80.00	0.004	0.02
Hedysarum	1	0.36	5	0.02	5.00	0.000	0.00
Lathyrus	27	9.78	1159	4.20	42.93	0.411	2.22
Ligusticum	1	0.36	15	0.05	15.00	0.000	0.00
Osmorhiza	13	4.71	780	2.83	60.00	0.133	0.72
Taraxacum	41	14.86	1873	6.79	45.68	1.008	5.44
Tragopogon	7	2.54	335	1.21	47.86	0.031	0.17
Trifolium	4	1.45	80	0.29	20.00	0.004	0.02
Umbelliferae-apiaceae	8	2.90	450	1.63	56.25	0.047	0.25
Liliaceae	1	0.36	40	0.14	40.00	0.001	0.01
Heracleum lanatum	10	3.62	780	2.83	78.00	0.102	0.55
Heuchera cylindrica	1	0.36	5	0.02	5.00	0.000	0.00
Lathyrus ochroleucus	1	0.36	40	0.14	40.00	0.001	0.01
Taraxacum officinale	15	5.43	709	2.57	47.27	0.140	0.76
Total root	3	1.09	235	0.85	78.33	0.009	0.03
Total forb	106	38.41	6900	25.00	65.09	9.601	27.49

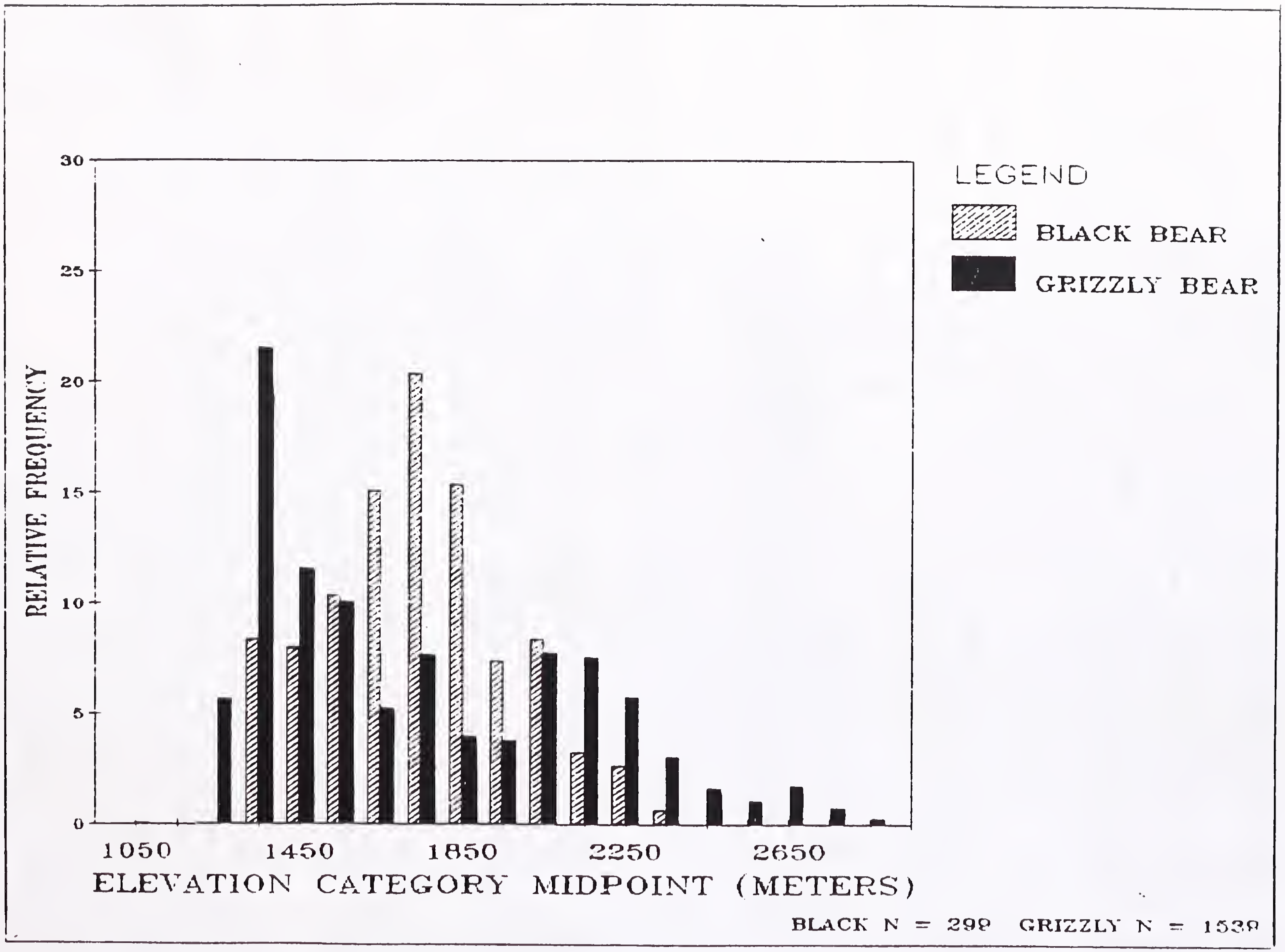


Figure 130. Black bear and grizzly bear use by elevation.

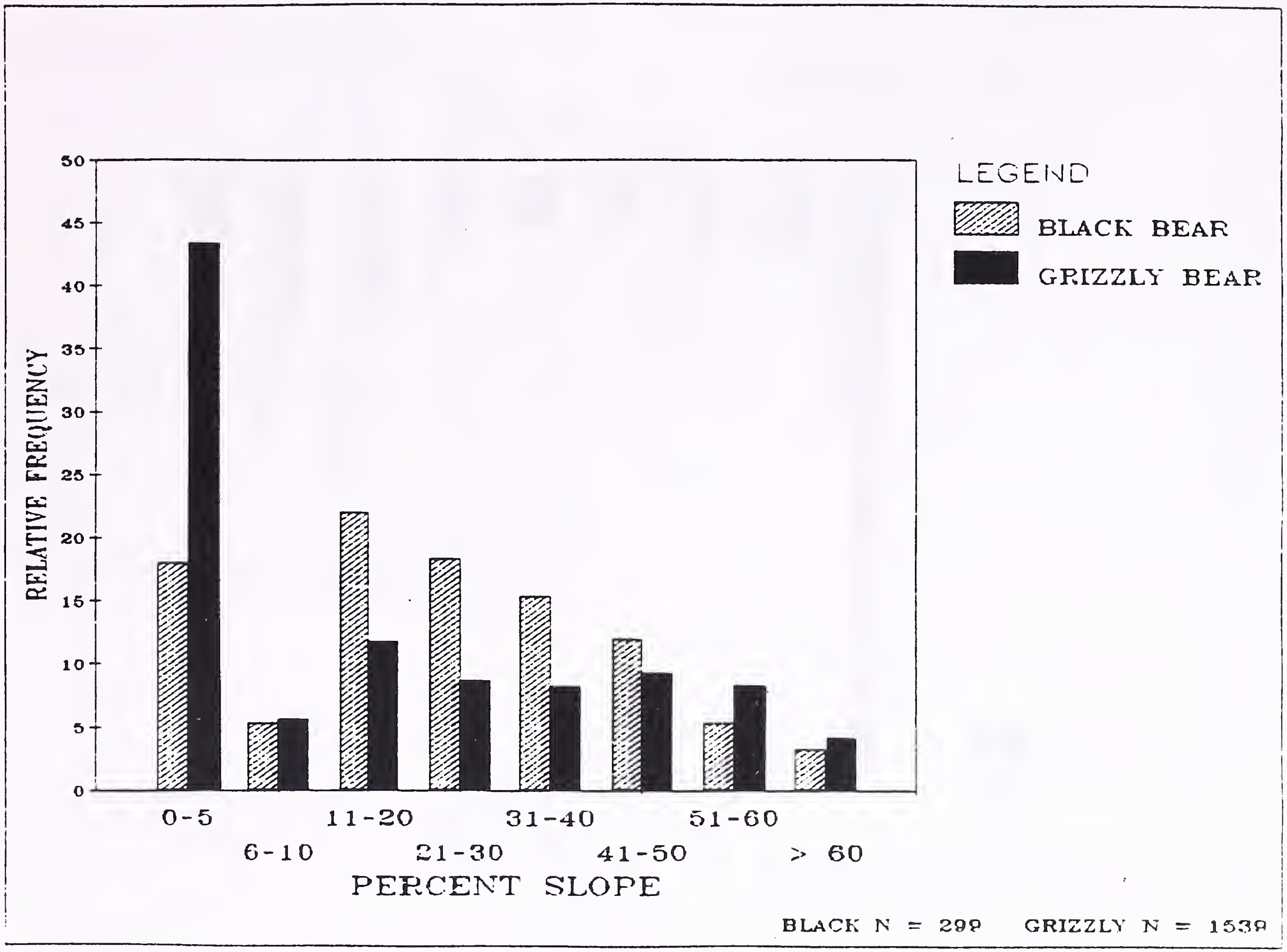


Figure 131. Black bear and grizzly bear use by slope.

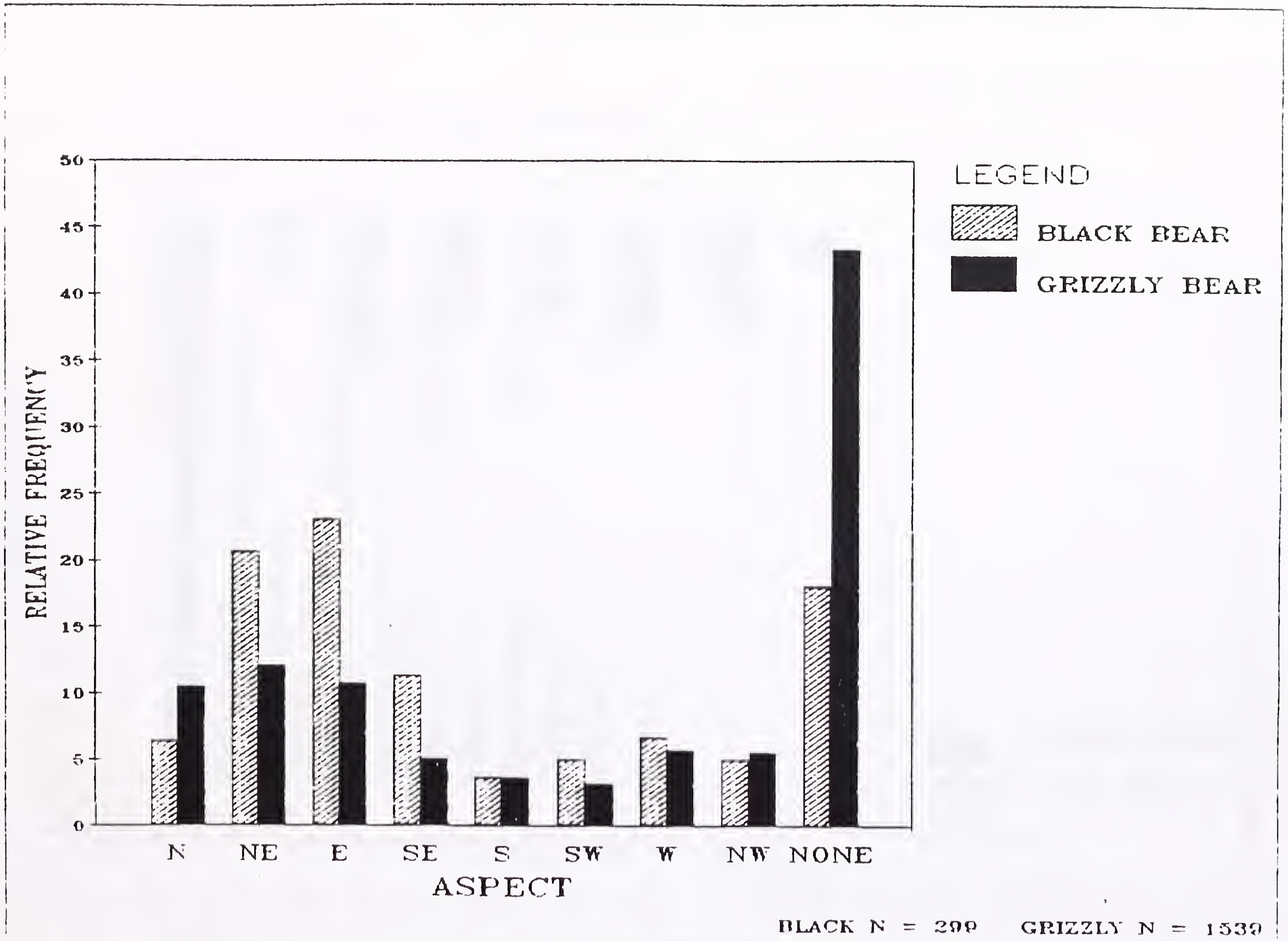


Figure 132. Black bear and grizzly bear use by aspect.

Table 97. Use/availability of habitat components by grizzly and black bears on the core area of the Rocky Mountain Front.

Habitat component	Preference/Avoidance Black bear	Preference/Avoidance Grizzly bear	Dominant species
Meadow	-	-	Equal
Road	-	-	Equal
Sidehill park	0	0	Equal
Snowchute	0	0	Equal
Shrubfield	0	0	Equal
Rock/talus/scree	-	0	Grizzly
Closed timber	+	+	Equal
Limber pine	+	-	Black
Prairie grassland	-	-	Equal
Mtn. grassland	0	-	Black
Populus stand	+	+	Equal
Riparian shrub	0	+	Grizzly
Riparian complex	-	-	Equal
Open timber	0	0	Equal
Timber shrubfield	0	0	Equal
Unknown	-	-	Equal

(-) equals avoidance
(+) equals preference
(0) equals proportional

Table 98. Black bear habitat use (percent) compared with grizzly bear habitat use for the core area.

Habitat component	Observed (black)	Expected (grizzly)	Difference (P=.05)
Meadow	.013	.005	0
Sidehill park	.017	.005	0
Snowchute	.010	.008	0
Shrubfield	.003	.005	0
Rock/talus/scree	.010	.081	-
Closed timber	.488	.259	+
Limber pine	.027	.030	0
Prairie grassland	.003	.031	-
Mtn. grassland	.013	.005	0
Populus	.231	.241	0
Riparian shrub	.027	.191	-
Riparian complex	.000	.012	-
Open timber	.120	.103	0
Timber shrubfield	.037	.008	0
Unknown	.000	.017	-

Grizzly and black bears were observed exploiting the same habitat within the same season. We speculate that in the components where both species overlapped in season of use, elevations selected, and food selection the competition was intense. During these times grizzlies were observed displacing black bears from a choice feed site or from a carcass or boneyard. Grizzlies have also been reported to kill black bears (Arnold 1930, Hornocker 1962, Jonkel and Cowan 1971, Murie 1981, Mace and Aune 1989). Such interactions could have important population regulation implications where these two species overlap in distribution.

A Comparison of the Impacts of Roads on Grizzly and Black Bears

In the core area, grizzly bears avoided the areas within 300 m. of open roads (Table 99). Black bear were avoiding the areas within 100 m. of any open roads. Black bears appear to be able to exploit habitat nearer the open roads. Kasworm and Manley (1988) also observed differences in displacement zones for black and grizzly bears in the Cabinet Mountains of Montana.

Table 99. Use/availability analysis for 100 meter distance categories for black and grizzly bears on the Rocky Mountain Front.

Distance category	Black bear	Grizzly bear
0-100	-	-
100-200	0	-
200-300	0	-
300-400	+	+
400-500	0	+
500 +	+	+

(-) equals avoidance.
(+) equals preference.
(0) equals proportional.

The use of habitat nearer roads by black bears suggests that this species can tolerate habitat disturbance to a greater extent than grizzly bears. The black bears ability to exploit disturbed habitats may provide a survival advantage to this species in heavily roaded habitats. Nagy and Russel (1978) suggested that as human encroachment and habitat disturbances increased in the Swan Hills region of Alberta, black bear densities increased while grizzly bear densities declined. The Rocky Mountain Front is not heavily roaded in comparison to other areas of western Montana. Increased roading of this area may displace grizzly bears while imparting a competitive advantage for black bears by decreasing competition for roadside habitat between the two species.

MANAGEMENT RECOMMENDATIONS

Rapid distributional recession and declines in grizzly bear populations occurring with the development of increased human activity has been well documented in Europe and North America (Martinka 1982, U.S. Fish and Wildlife Service 1981, Roben 1980, Cowan 1972, Mysterud 1980, Buchalczyk 1980, Markov 1980, Roth 1976, Elgmork 1978, Grachev 1976, Kaal 1976, Vereschagin 1976, Pearson 1975, Curry-Lindahl 1972, Stebler 1972, Zunino and Herrero 1971, Guilday 1968, Buss 1956 and Storer and Trevis 1955). Human activities within grizzly bear range have and will continue to have effects, however subtle, on grizzly bears. The recommendations included here, are suggested ways to reduce the significant conflicts we observed between humans and grizzly bears. Implementation of these recommendations may ensure population maintenance and preserve the habitat critical to this species survival on the Rocky Mountain Front.

Habitat Management

Management guidelines developed by the Interagency Wildlife Monitoring and Evaluation Program were developed as a direct result of grizzly bear monitoring conducted on the east front (Appendix G). If followed, these guidelines will mitigate but not eliminate detrimental influences of human activities on grizzly bears and grizzly bear habitat. It is recommended that these guidelines become the accepted practice for land management agencies along the Rocky Mountain Front.

In addition, land management programs which establish permanent protection to bear habitat are recommended including establishing additional wilderness areas, wildlife management areas, special management areas and the purchase/easement of private lands by conservation groups. Although these programs may meet public resistance, they should be actively pursued when possible and courteously discussed with the public.

Habitat improvement programs should be implemented on public lands including direct influences on the physical-vegetative composition of land and the reduction of human impacts to provide increased security. Direct influences include long-term planning and application of controlled burns. These efforts should be aimed at opening the forest canopy in select sites. Considering the recent natural burns which occurred on the front, much of this may have been accomplished. In some of the wetter forests in the northern portions of the study area, however, burning may still have application.

Cumulative Effects

Recent studies in North America have expressed concerns regarding increasing human access and activities within grizzly bear habitat. The influences of timber harvest, livestock grazing, boneyards and dumps, recreation, sport hunting, road access, mining, subdivision, and hydrocarbon development have been discussed (Craighead 1979, 1980, Craighead and Craighead 1967, 1971, 1973, 1974; Knight et al. 1975, 1976, 1977, 1978, 1980, 1980a, 1981; Chester 1976, Jonkel and Servheen 1977, Jonkel 1976, 1977, 1978, 1980; Harding and Nagy 1980; Schallenberger and Jonkel 1980, Knight and Judd 1980, Blanchard 1978, 1980; Servheen 1981, Pearson 1975, Reynolds and Hechtel 1980, Nagy and Russell 1978, Russell et al. 1978, Hamer et al. 1977, Mundy and Flook 1973). Each activity contributes an additive stress to grizzly bear populations. It is recommended that responsible agencies continue to develop the ongoing cumulative effects model to measure relative impacts of various human activities. Modeling results should be biologically validated using scientific research techniques and the existing grizzly bear data base. The model should be continually refined as knowledge and data indicate a need for revision and refinement.

Habitat Mapping

To assess the cumulative impacts of land management activities a complete data base including bear distribution and use as well as grizzly bear habitat is needed. On the Rocky Mountain Front habitat in two of six BMU's has been mapped. It is recommended that the Rocky Mountain Front be entirely mapped using the component classification system developed for the area or potentially by LANDSAT multispectral or thematic imagery providing that ground truthing and vegetation analysis is conducted to verify the spectral classifications applied to the area. The accuracy of habitat maps and the consistency of mapping techniques should continue to remain high if such a data base is to be used in project level cumulative effects analysis. A cumulative effects analysis model and accurate habitat mapping will require a long term commitment to these efforts and broad interagency support.

Research Studies

The relationship of grizzly bears to all types of human activities as well as oil and gas development must be understood. Future monitoring programs should be further directed and focused toward filling important gaps in the data base. Intensive efforts to gather data pertaining to livestock/bear relationships, population estimation, oil and gas development impacts, the role of sport hunting, the effects of animal depredation control programs, and the interaction of black and grizzly bears deserve further investigation. Field emphasis should be directed toward securing baseline data in the south half of the Badger-Two Medicine BMU, the area south of the Sun River, and the remote backcountry areas.

Regional Management Plans

It is recommended that work continue on the Montana Department of Fish, Wildlife, and Parks zoned management plan for the east front. Regional Management Plans are essential to proper direction and designing programs to achieve specific goals. Efforts should be made to coordinate regional plans with existing interagency programs and recovery objectives for grizzly bears. Mortality and population trend monitoring programs should be outlined in the management plan so that program revisions and refinements can be made.

A comprehensive livestock boneyard management program is essential to the implementation of zoned management of bears. Recent movements of grizzlies east toward Choteau has been observed and is directly linked to drought conditions and major boneyards encouraging bears to remain within these areas. Recent problems in Dupuyer were related to the refuse site adjacent to the community. Agencies, county governments, and private landowners must develop a cooperative attitude and direct efforts toward removing these attractants to reduce potential conflicts. Possible methods include incineration, bear-proof disposal canisters or pits, and the removal of refuse to an appropriate location or rendering plants.

A second critical management need for proper implementation of the zoned management program is the development of deterrent and aversive conditioning techniques which are easily applied in the field. Recent studies of bear behavior suggest a few are available (Hunt 1985). High visibility electric fencing around beehives did reduce depredations west of Choteau in 1985 and 1986. Continued experimentation in fencing techniques and applications are recommended. Testing of chemical deterrents and repellents in select situations is recommended. The experimental rubber thumper gun is a useful tool which can be used to modify behavior of young bears too accustomed to ranch homes or roads where they are highly visible and at risk. Research on these and other techniques, public education as to the needs for these tools, and consistent application could prevent serious damage problems in the future. The zoned management program must focus efforts toward field techniques which prevent problems and avoid the commonly unsuccessful relocation of problem bears.

A third critical component of the zoned management plan is the implementation of carcass redistribution especially during the phasing out of lowland boneyards. A few scattered carcasses at controlled sites within the public lands could detain bears for short periods during the spring. This practice could hold bears in the foothills regions and safe zones of the front to keep them from increasing use of private lands further east. The program should not become a feeding program which causes a major introduction of carrion into the system. In fact, the total number of carcasses relocated should not exceed two per square mile and not more than 10 to 20 carcasses a year. Each site should be carefully selected and not used more than twice each five years.

The fourth critical component of a management plan for the Rocky Mountain Front is a well designed (both in time and space) hunting season. Hunting programs on the Rocky Mountain Front should be designed to surgically remove excess bears from high conflict areas or poorly behaved bears. Use of damage control hunts at selected sites on selected individuals is one method which can work when properly applied. Hunting seasons structured to harvest bears along the eastern periphery of the front could be used to select for bears frequenting the lowlands. Season design should be compatible with goals in each of the management zones and the needs of the private landowners. The season should be structured to target the eastern zones longer, and then progress toward the wilderness regions or until the quota is reached.

Mortality

Revision and refinement of the management programs along the front must be correlated with the population biology of this species. Application of control programs and hunting seasons should be linked to information on production and population trend. In the last few years, mortality rates experienced by the east front grizzly population have risen dramatically. Although not unusual for severe drought years, mortality rates of recent may be too high to be sustained. Limits on the mortality may be needed if relief is not observed during the next year. On the Rocky Mountain Front, the mortality data and population trend indicate that an average known mortality of four bears per year did not cause the population to decline. The mortality during this period ranged from one to eight. It should not exceed eight bears in any one year until new data indicates the population can sustain increased mortality.

In addition, south of the Sun River, increased protection for females is needed. We did not observe high rates of production in this area and marked few females during the study. It is recommended that all females be considered essential to the long term health of grizzly populations in these particular bear management units. Concerted efforts to reduce female mortality because of hunting, illegal killing, and management activity is needed. This is particularly important in light of the recent fires affecting this area reducing the cover and temporarily retarding forage production. The long term consequences of the fires in this unit are beneficial to bears, but in the short term the region has been reduced in its ability to provide food for female grizzly bears.

Relocation of Grizzly Bears

In recent years many problem bears are captured and relocated. Given the high rate of annual mortality observed in problem bears, it is apparent that the success of this program in improving the population status is limited. The potential to provide a bear the opportunity of contributing genetically to the population is extremely limited following a relocation. Each relocated bear must not only survive the first year beyond the relocation it also must survive sufficiently long enough to participate in the reproductive process. Thus a relocated yearling bear must survive not one year but four while a four-year old female could become a contributor to the population in the next year. If relocated bears do not survive to contribute to the population, then they are simply taking up space and resources which other bears may need.

In some cases relocation does alleviate the immediate problem, however, it has seldom resulted in the long term survival of any individual. It's overall success must be weighed according to the desired result. It is recommended that the relocation programs in the Northern Continental Divide be examined to determine how successful the program has been in protecting individuals so that they survive to contribute genetically to the population.

Our results indicate that the survival of relocated bears is so low that it may not be supported except in the case of female bears who are soon able to contribute to the reproductive process or adult females who are reproducing individuals.

Few male bears would be good candidates for relocation. Subadult males in particular face high mortality rates naturally (.28-.35 annual mortality rate) and have extremely low survival rates after their first relocation (.11-.09 annual survival rate for subadults). In addition they must survive for three to four years after the infraction to become contributors to the gene pool (3.9-2.6 percent chance of survival through year 4). Male bears removed from the system rather than relocated under the mortality quota regulation can also translate into one less female removed at a later date.

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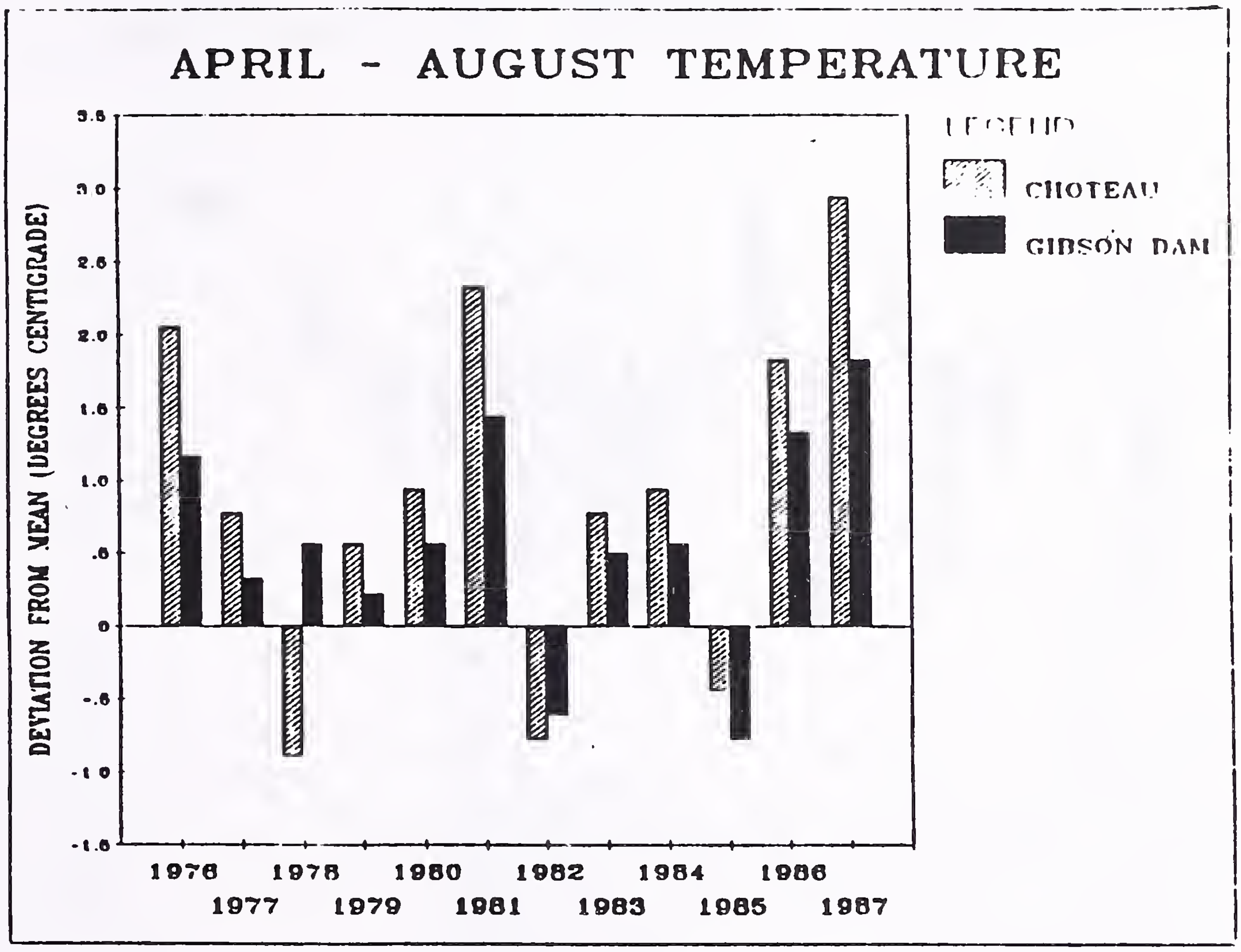
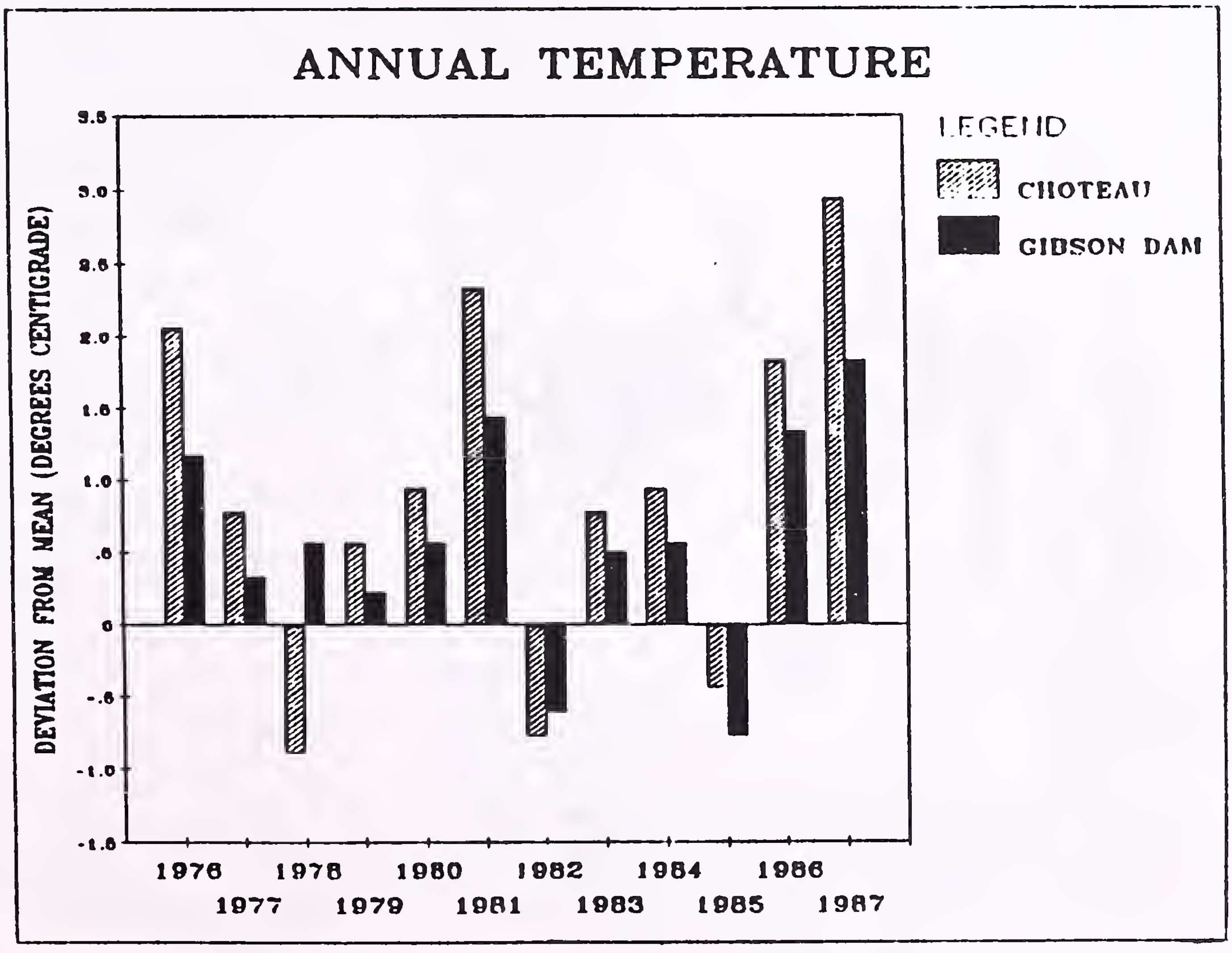
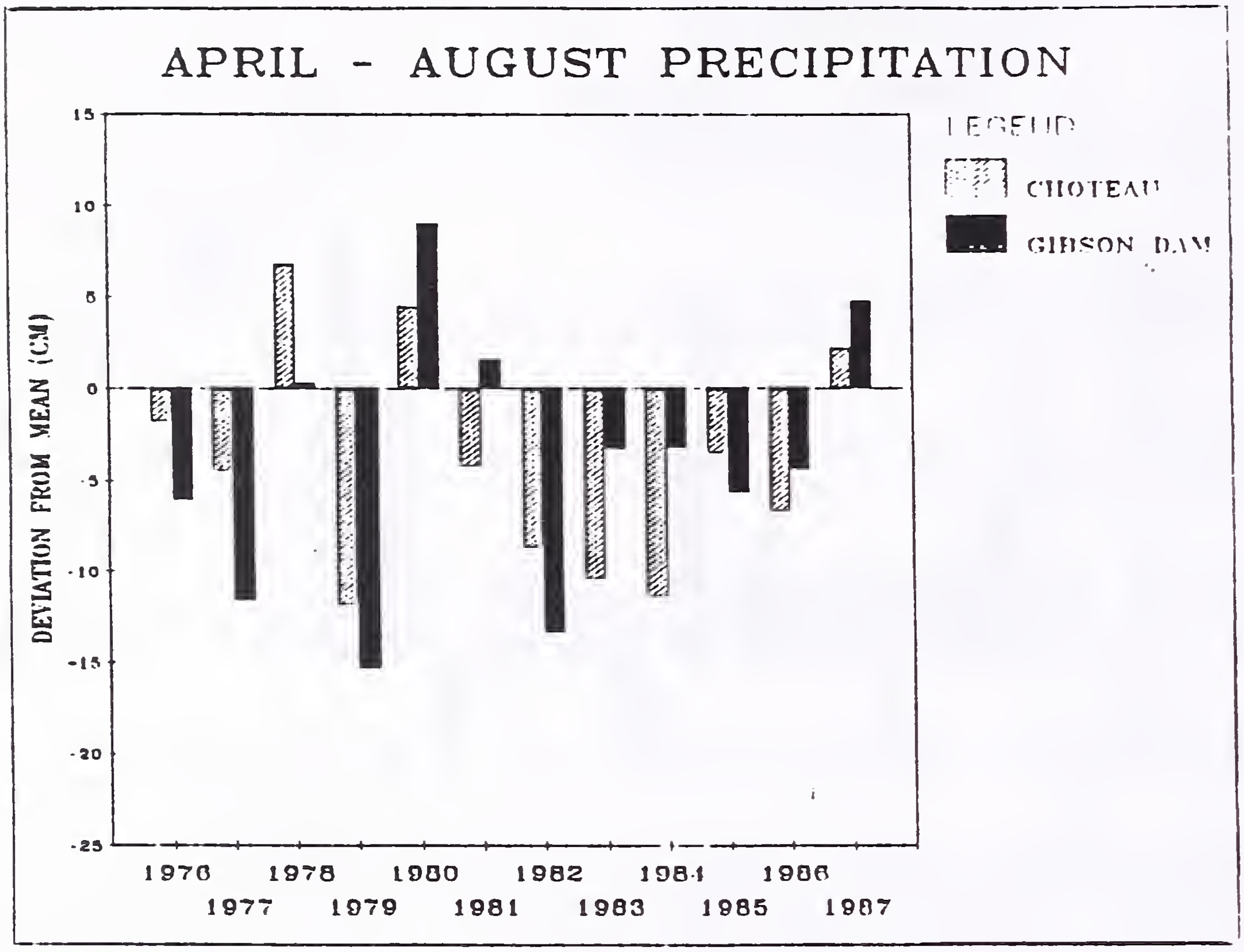
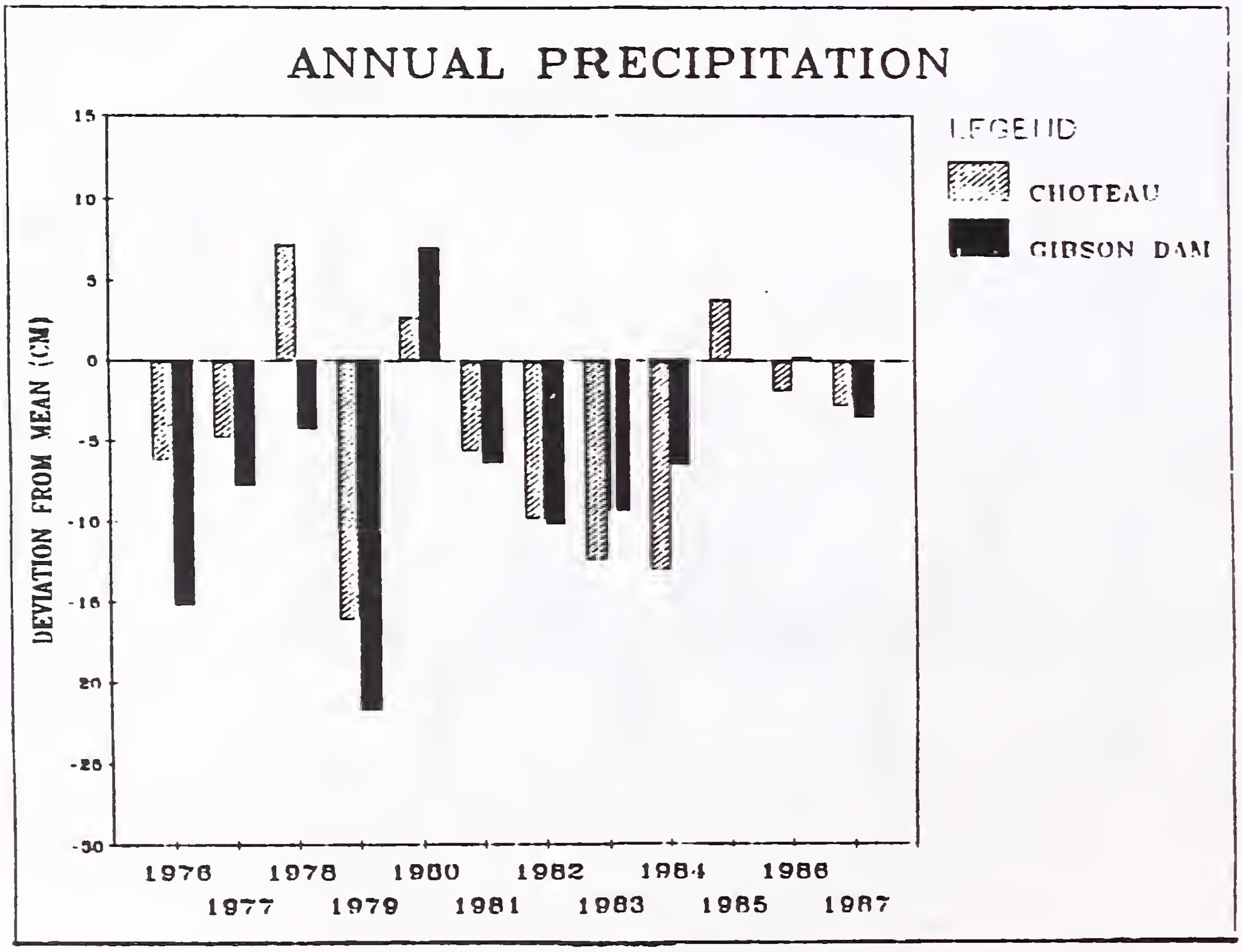
Appendix A. Climatological data from the Rocky Mountain Front, 1976-87.





Appendix A. Climatological data from the Rocky Mountain Front, 1976-87. (continued)





Appendix B. Species and common names of East Front Rocky Mountain plants. Arranged alphabetically by life form. Nomenclature follows Hitchcock and Cronquist (1974). (Carex follows Hermann 1970.) Sources where species were reported in literature include: 1. Harvey (1980); 2. Lessica (1982); 3. Kasworm (1980); 4. Ihsle (1981); 5. Thompson (1980); and 6. Joslin (1982). Plant collections are kept by (A) Bureau of Land Management; (B) Montana Department of Fish, Wildlife and Parks, and (C) The Nature Conservancy.

Plant No.	Scientific binomial	Common name	Source	Plant Collection
Trees				
0010	Abies lasiocarpa	Subalpine fir	5,6	
0020	Juniperus scopulorum	Rocky Mtn. juniper	1,3,4	A,B
0030	Picea engelmannii	Engelman spruce	1,2,3,4	A,B,C
0040	Pinus albicaulis	Whitebark pine	6	
0050	Pinus contorta var. latifolia	Lodgepole pine	1,3,4	A,B
0060	Pinus flexilis	Limber pine	1,3,4,5,6	A,B
0065	Populus angustifolia	Narrow-leaf cottonwood	2	C
0070	Populus tremuloides	Quaking aspen	1,2,3,4	A,B,C
0080	Populus trichocarpa	Black cottonwood	1,2	A,C
0090	Pseudotsuga menziesii	Rocky Mtn. douglas fir	1,2,3,4,5,6	A,B,C
0100	Total Trees			
Tall Shrubs				
0110	Acer glabrum	Rocky Mountain maple	1,6	A,B
0120	Alnus sinuata	Sitka alder		A,C
0130	Betula glandulosa	Bog birch	2	
0140	Betula occidentalis/occidentalis	Water birch	1,2,3,4,	A,B,C
0145	Betula spp.	Genera		
0150	Cornus stolonifera/stolonifera	Red-osier dogwood	1,2	A,C
0160	Elaeagnus commutata	Silverberry	1,2,3,4	A,B,C
0170	Salix brachycarpa	Short fruited willow		A
0180	Salix bebbiana/perrostrata	Bebb willow	1,2,3	A,B,C
0185	Salix candida	Hoary willow	2	C
0190	Salix commutata	Variable willow		A
0200	Salix drummondiana	Drummond willow	2	A,C
0210	Salix exigua ssp exigua/stenophylla	Narrow-leaf willow	1,2	B,C
0220	Salix monticola	Mountain willow	1,2	A,C
0230	Salix myrtillifolia	Blueberry willow	1,2	A,C
0238	Salix phylicifolia/planifolia	Tea-leaved willow	2	C
0240	Salix rigida/mackenzieana	Mackenzie willow	1	A,B
0241	Salix rigida/watsonii	Watson willow	2	C
0250	Salix scouleriana	Scouler willow	1	A
0253	Salix serrissima	Fall willow	2	C
0260	Salix spp.	Genera		
0261	Sorbus sitchensis	Mountain ash		
0265	Total Tall Shrubs			
	Medium Shrubs			
0270	Amelanchier alnifolia/alnifolia	Western serviceberry	1,2,3,4,6	A,B,C
0280	Artemesia tridentata ssp. vaseyana	Mountain big sagebrush	1,3,4	A,B
0285	Cercocarpus ledifolus	Curly leafed mountain mahogany		
0290	Chrysothamnus nauseosus/petrophilus	Common rabbit-brush	1	B
0295	Crataegus douglasii	Hawthorn		
0300	Juniperus communis/montana	Common juniper	1,2,3,4,6	A,B,C
0310	Lonicera involucrata	Black twin-berry		A
0320	Lonicera utahensis	Utah honeysuckle		A
0325	Menziesia ferrigina	Menziesia		
0330	Philadelphus lewisii	Mockorange	1,6	B
0340	Potentilla fruticosa	Shrubby cinquefoil	1,2,3,4,5,6	A,B,C,
0350	Prunus virginiana/melanocarpa	Common chokecherry	1,2,3,4,6	A,B,C
0360	Rhus trilobata	Skunkbush sumac	1,3,4	A,B
0365	Ribest americanam	Black currant		
0370	Ribes cereum/inebrians	Squaw currant	1,2,3,4	A,B,C
0380	Ribes inerme	Whitestem gooseberry	1,3,4	A,B
0390	Ribes lacustre	Prickly currant	1	A,B
0400	Ribes montigenum	Sticky currant		

0410	Ribes setosum	Missouri gooseberry	2	C
0415	Ribes viscosissimum	Sticky currant	6	A
0420	Ribes ssp.	Genera		
0430	Rosa acicularis	Prickly rose	1	B
0440	Rosa arkansana	Arkansas rose	1,3	A,B
0450	Rosa woodsii/ultramontana	Pearhip rose	1,2,3	A,B,C
0460	Rosa spp.	Genera		
0470	Rubus idaeus/peramoenus	Red raspberry	1,2,6	B,C
0480	Rubus parviflorus	Thimbleberry	1	B
0489	Sambucus cerulea	Blue elderberry		
0490	Sambucus racemosa	Black elderberry		
0500	Shepherdia argentea	Thorny buffalo-berry		A
0510	Shepherdia canadensis	Canada buffalo-berry	1,2,3,4,5,6	A,B,C
0520	Spirea betulifolia/lucida	Shiny-leaf spirea	1,2,3,4,6	A,B,C
0523	Spirea densiflora	Subalpine spirea		
0525	Spirea spp.	Genera		
0530	Symphoricarpos albus/albus	Common snowberry	1,3,6	A,B
0540	Symphoricarpos occidentalis	Western snowberry	2,3,4	A,C
0542	Symphoricarpos oreophilus	Mtn. snowberry		
0550	Tetradymia canescens	Gray horse-brush	1	B
0560	Vaccinium globulare	Globe huckleberry	6	A
0565	Total Medium Shrubs			
	Low Shrubs and Vines			
0570	Arctostaphylos uva-ursi	Kinnikinnick	1,2,3,4,5,6	A,B,C
0575	Artemesia biennis	Biennial wormwood	1,2	B,C
0578	Artemesia campestris ssp borealis/ scouleriana	Northern wormwood	1,3,4	A,B
0580	Artemisia cana	Hoary sagewort	3	A
0582	Artemesia dracunculus	Dragon sagewort	1	B
0585	Artemisia frigida	Fringed sagewort	1,3,4	A,B
0588	Artemesia ludoviciana/ludoviciana	Cudweed sagewort	1,3,4	A,B
0589	Artemesia ludoviciana/latiloba	Western mugwort	1	B
0590	Artemesia michauxiana	Michaux mugwort	1,5	B
0595	Artemesia spp.			
0600	Berberis repens	Oregongrape	1,2,3,4,6	A,B,C
0605	Chimaphila umbellata	Common priucas pine		A
0610	Clematis columbiana/columbiana	Columbia clematis	1,6	A,B
0620	Clematis ligusticifolia	Western clematis	1,2	B,C
0630	Clematis pseudoalpina	Climbing purple virgins-bower	3,4,6	A
0640	Clematis tenuiloba	Matted purple virgins-bower		
0650	Dryas octopetala/hookeriana	White dryas	1,5,6	B
0660	Gutierrezia sarothrae	Broom snakeweed	1	B
0670	Juniperus horizontalis	Creeping juniper	1,2,3,4,6	A,B,C
0675	Linnea borealis	Twinflower		A
0680	Ledum glandulosum	Mountain labrador-tea		A
0685	Phyllodace empetriformis	Pink mountain heather		
0690	Vaccinium myrtillus	Dwarf huckleberry		A
0699	Vaccinium caespitosum	Dwarf bilberry		
0700	Vaccinium scoparium	Whortleberry		
0710	Total Low shrubs and Vines			
	Ferns and Fern Allies			
0712	Athyrium filix-femina	Lady-fern	2	C
0715	Botrychium virginianum	Virginia grape-fern	2	C
0717	Cystopteris fragilis	Brittle bladder-fern	1	B
0720	Equisetum arvense	Common horsetail	1,2	B,C
0730	Equisetum fluviatile	Water horsetail		
0740	Equisetum laevigatum	Smooth scouring-rush	1,2	A,B,C
0750	Equisetum pratense	Shady horsetail		
0755	Equisetum spp.	Genera		
0760	Equisetum variegatum	Northern scouring-rush	2	C
0770	Mushroom spp.			
0780	Selaginella densa/densa	Compact selaginella	1,4,6	B
0790	Thelypteris phegoptesis	Wood fern		
0798	Woodwardia fimbriata	Chain-fern	6	

0800	Total Ferns and Fern Allies			
	Graminoides			
0810	Agropyron caninum spp. majus/majus	Slender wheatgrass	1,2,4,5,6	A,B,C
0820	Agropyron caninum spp. majus/andinum	Bearded wheatgrass	1,2	B,C
0825	Agropyron Caninum ssp. majus/latiglume	Broad glumed wheatgress		
0830	Agropyron cristatum	Crested wheatgrass	1	B
0840	Agropyron dasytachyum	Thick-spiked wheatgrass	1,3,4	A,B
0845	Agropyron intermedium	Intermediate wheatgress		
0850	Agropyron repens	Quack grass	1,2	C
0860	Agropyron scribneri	Spreading wheatgrass	5	
0870	Agropyron smithii	Western wheatgrass	1,2,6	B,C
0880	Agropyron spicatum/spicatum	Bluebunch wheatgrass	1,3,4,6	A,B
0890	Agropyron spp.	Genera		
0900	Agrostis alba/alba	Redtop	1,2	B,C
0905	Agrostis thurberiana	Thurber bentgrass	6	
0907	Agrostis spp.	Genera		
0910	Alopecurus aequalis	Short-awn foxtail	2	C
0911	Alopecurus alpinus	Alpine foxtail	1,2	B,C
0918	Alopecurus geniculatus	Water foxtail	2	
0920	Andropogon scoparius	Little bluestem	1	B
0930	Aristida fendleriana	Fendlers threeawn	1	B
0940	Aristida longiseta/robusta	Red threeawn	1	B
0950	Avena fatua	Wild oat	1	B
0960	Beckmannia syzigachne	American sloughgrass	1,2	B,C
0970	Bouteloua gracilis	Blue grama	1	B
0980	Bromus carinatus/carinatus	Mountain brome	1,2,3,4,5	A,B,C
0990	Bromus carinatus/linearis	California brome	1	B
0993	Bromus ciliatus	Fringed brome	2,5	C
1000	Bromus inermis spp. inermis	Smooth brome	1,2,3,4,5	A,B,C
1010	Bromus inermis spp. pumpellianus/ pumpellianus	Pumpelly brome	1	B
1020	Bromus japonicus	Japanese brome	1	B
1030	Bromus tectorum	Cheatgrass	1,3,4	A,B
1035	Bromus spp.			
1040	Calamagrostis canadensis	Bluejoint reedgrass		A
1050	Calamagrostis inexpansa/inexpansa	Narrow-spiked reedgrass	1,2	B,C
1055	Calamagrostis montanensis	Plains reedgrass	2	C
1060	Calamagrostis neglecta/neglecta	Slimstem reedgrass	1	B
1070	Calamagrostis purpurascens	Purple pinegrass	1,5,6	A,B
1080	Calamagrostis rubescens	Pinegrass	1,4,6	B
1090	Calamovilfa longifolia	Prairie sand reedgrass	1	B
1100	Carex aquatilis	Water sedge	1,2	B,C
1101	Carex atherodes	Awned sedge	2	C
1102	Carex athrostachya	Slenderbeaked sedge	2	C
1103	Carex aurea	Golden sedge	2	C
1105	Carex buxbaumii	Buxbaum's sedge	2	C
1107	Carex capillaris	Hair sedge	2	C
1110	Carex concinnoides	Northwest sedge		
1111	Carex crawei	Craw's sedge	2	C
1115	Carex diandra	Panicled sedge	2	C
1116	Carex dioica	Yellow bog sedge	2	C
1117	Carex disperma	Soft leaved sedge	2	C
1118	Carex douglasii	Douglas' sedge	2	C
1120	Carex filifolia	Thread-leaved sedge	1,3,4	A,B
1130	Carex geyeri	Elk sedge	1,6	B
1140	Carex hoodii	Wire sedge	1	B
1143	Carex interior	Inland sedge	2	C
1150	Carex lanuginosa	Woolly sedge	1,2	B,C
1151	Carex lasiocarpa	Slender sedge	2	C
1152	Carex leptalea	Bristle-stalked sedge	2	C
1153	Carex limosa	Shore sedge	2	C
1154	Carex livida	Pale sedge	2	C
1160	Carex microptera	Small-winged sedge	2	A,C
1170	Carex muricata	Muricate sedge		A
1180	Carex nebraskensis	Nebraska sedge	2,3,4	A,C

1183	Carex oederi	Green sedge	2	C
1188	Carex parryana	Parry sedge	2	C
1190	Carex praegracilis	Clustered field sedge	1,2	B,C
1200	Carex raynoldsii	Raynolds' sedge		A
1205	Carex rossii	Ross sedge	6	
1210	Carex rostrata	Beaked sedge	1,2	B,C
1220	Carex rupestris/drummondii	Curly sedge	1	B
1227	Carex sartwellii	Sartwell's sedge	2	C
1230	Carex scirpoidea	Single-spiked sedge	1,2	B,C
1233	Carex simulata	Short-beaked sedge	2	C
1240	Carex stenophylla	Narrow-leaved sedge	2,4	C
1250	Carex xerantica	Dryland sedge	3,4	A
1260	Carex spp.	Genera		
1270	Dactylis glomerata	Orchard-grass	1,2	B,C
1275	Danthonia californica	California oatgrass	2	C
1280	Danthonia intermedia	Timbered oatgrass	4,6	
1290	Danthonia parryi	Parry's oatgrass	1	B
1300	Danthonia unispicata	Few-flowered wild oatgrass	4	
1310	Danthonia spp.	Genera		
1320	Deschampsia cespitosa/cespitosa	Tufted hairgrass	1,2,5,6	B,C
1330	Deschampsia elongata	Slender hairgrass	3,4	A
1340	Distichlis stricta/stricta	Alkali saltgrass	1	B
1350	Echinochloa crusgalli	Large barnyard-grass		
1360	Eleocharis acicularis	Needle spike-rush	1	B
1370	Eleocharis palustris	Common spike-rush	1,2	B,C
1371	Eleocharis parvula	Small spike-rush	2	C
1372	Eleocharis pauciflora	Few-flowered spike-rush	2	C
1375	Eleocharis tenuis	Slender spike-rush	2	C
1380	Elymus cinereus/cinereus	Basin wildrye	1	B
1390	Elymus glaucus	Western rye-grass	2	A,C
1395	Eriophorum polystachion	Cotton-grass	2	C
1397	Eriophorum scheuchzeri	Cotton-grass		
1400	Eriophorum viridicarinatum	Green keeled cotton-grass	2	C
1410	Festuca idahoensis/idahoensis	Idaho fescue	1,3,4,5,6	A,B
1420	Festuca ovina	Sheep fescue	4,5,6	
1430	Festuca pratensis	English fescue	1,2	B,C
1440	Festuca scabrella	Rough fescue	1,3,4,5,6	A,B
1450	Glyceria grandis	American mannagrass	1,2	B,C
1452	Glyceria striata	Fowl mannagrass	2	C
1460	Helictotrichon hookeri	Spike-oat	1,4	B
1470	Hordeum jubatum	Foxtail barley	1,2	B,C
1480	Juncus alpinus	Northern rush	1,2	B,C
1490	Juncus balticus/montanus	Wire rush	1,2	B,C
1492	Juncus bufonius	Toad rush	2	C
1500	Juncus longistylis	Long-styled rush	2,3,4	A,C
1510	Juncus nodosus	Tuberous rush	1,2	B,C
1515	Juncus tenuis	Slenber rush	2	C
1516	Juncus torreyi	Torry's rush	2	C
1520	Juncus trayci	Tracy's rush	1,2	B,C
1530	Juncus spp.	Genera		
1540	Koeleria cristata	Prairie junegrass	1,3,4,6	A,B
1550	Luzula hitchcockii	Smooth woodrush		A
1560	Muhlenbergia cuspidata	Plains muhly	1,3,4	A,B
1565	Muhlenbergia glomerata	Marsh muhly	2	C
1567	Muhlenbergia richardsonis	Mat muhly	2	C
1568	Muhlenbergia spp.	Genera		
1570	Oryzopsis hymenoides	Indian ricegrass	1	B
1580	Phalaris arundinacea	Reed canarygrass	1,2	B,C
1590	Phleum alpinum	Alpine timothy	5,6	
1600	Phleum pratense	Common timothy	1,2,3,4	A,B,C
1603	Poa alpina	Alpine bluegrass	5,6	
1605	Poa annua	Annual bluegrass	2C	
1610	Poa compressa	Canada's bluegrass	1	B
1620	Poa cusickii	Cusick's bluegrass	3,5	A
1625	Poa fendleriana	Muttongrass	6	
1630	Poa interior	Inland bluegrass	2,5	C
1635	Poa juncifolia	Alkali bluegrass	2	C

1640	Poa nervosa/wheeleri	Wheeler's bluegrass	1,5	B
1650	Poa nevadensis	Nevada bluegrass	1	B
1660	Poa pratensis	Kentucky bluegrass	1,2,3,4,6	A,B,C
1670	Poa rupicola	Timberline bluegrass	5	
1680	Poa sandbergii	Sandberg's bluegrass	1,3,4,5,6	A,B
1690	Poa scabrella	Pine bluegrass	2	C
1700	Poa spp.		Genera	
1705	Puccinellia distans	Weeping alkaligrass	2	C
1710	Scirpus acutus	Hardstem bulrush	1,2	B,C
1711	Scirpus americanus	American bulrush	2	C
1719	Scirpus maritimus	Seacoast bulrush	2	C
1720	Scirpus microcarpus	Small-fruit bulrush	1,2	B,C
1725	Scirpus spp.	Genera		
1727	Sitanion hystrix	Squirreltail	5,6	
1730	Spartina gracilis	Alkali cordgrass	1,2	B,C
1740	Stipa comata/comata	Needle and thread	1,4	B
1750	Stipa occidentalis/minor	Western needlegrass	1,3,4	A,B
1760	Stipa spartea/curtiseta	Porcupine needlegrass	1	B
1770	Stipa richardsonii	Richardson's needlegrass		
1780	Stipa viridula	Green needlegrass	1,3,4	A,B
1790	Trisetum canescens	Tall trisetum		
1800	Trisetum spicatum	Downy oatgrass	5	A
1803	Typha latifolia	Common cattail	1	B
1805	Unknown cyperaceos			
1810	Unknown graminae			
1815	Unknown juncaceae			
1820	Total Graminoids			
	Forbs			
1830	Achillea millefolium ssp. lanulosa/ lanulosa	Common yarrow	1,2,3,4,5,6	A,B,C
1840	Actea rubra	Western red baneberry	1,2	B,C
1850	Actea rubra/neglecta	Western white baneberry	1	B
1860	Agoseris glauca/dasycephala	Pale agoseris	1,3,4,6	A,B
1862	Agoseris aurantiaca	Orange agoseris		
1865	Agoseris spp.	Genera		
1870	Allium cernuum	Nodding onion	1	B
1878	Allium schoenoprasum	Chives	2	C
1880	Allium textile	Textile onion	1,3,4	A,B
1890	Allium spp.	Genera		
1900	Alyssum alyssoides	Pale alyssum	1,3,4	A,B
1910	Amaranthus californicus	California amaranth	1	B
1915	Anaphalis margaritacea	Pearly-everlasting		
1920	Androsace lehmanniana	Sweet-flowered androsace	1,6	B
1930	Androsace septentrionalis	Northern androsace	1,6	B
1940	Anemone multifida/multifida	Pacific anemone	1,2,3,5,6	A,B,C
1950	Anemone nuttalliana	Pasqueflower	3,6	A
1960	Anemone parviflora	Small-flowered anemone	2	C
1970	Anemone piperi	Piper's anemone		
1975	Anemone spp.	Genera		
1980	Angelica arguta	Sharptooth angelica	1,2	A,B,C
1990	Angelica spp.	Genera		
1995	Antennaria alpina	Alpine pussy-toes	6	
2000	Antennaria anaphaloides	Tall pussy-toes	1,2	A,B,C
2005	Antennaria arcuata	Arching pussy-toes		B
2010	Antennaria microphylla	Rosy pussy-toes	1,2,3,4	A,B,C
2012	Antennaria neglecta	Field pussy-toes	6	
2020	Antennaria parvifolia	Nuttall's pussy-toes	1	B
2030	Antennaria racemosa	Raceme pussy-toes	1	A,B
2032	Antennaria rubella		6	
2035	Antennaria spp.	Genera		
2036	Antennaria umbrinella	Umber pussy-toes	6	
2040	Apocynum medium	Western dogbane	1,4	B
2050	Aquilegia flavescens	Yellow columbine	1,3	A,B
2060	Aquilegia jonesii	Limestone columbine		A
2063	Arabis glabra	Towermustard	2	C

2065	Arctium minus	Burdock	2	C
2066	Arctium lappa	Burdock		
2070	Arenaria capillaris/americana	Thread-leaved sandwort	1,5	B
2080	Arenaria congesta	Ballhead sandwort	3,4,6	A
2085	Arenaria hookeri	Hooker's sandwort	6	
2090	Arenaria lateriflora	Bluntleafed sandwort	2	C
2095	Arenaria nuttallii	Nuttals sandwort		
2100	Arenaria obtusiloba	Arctic sandwort	1,5	B
2110	Arenaria rossii/apetala	Ross sandwort	1	B
2112	Arenaria aculeata	Prickly sandwort		
2115	Arenaria spp.	Genera		
2118	Arnica alpina	Alpine arnica	6	
2120	Arnica cordifolia/cordifolia	Heart-leaf arnica	1,2,3,4,6	A,B,C
2130	Arnica fulgens	Orange arnica	1	B
2140	Arnica latifolia	Mountain arnica		
2142	Arnica longifolia	Seep-spring arnica	6	
2150	Arnica mollis	Hairy arnica	5	
2151	Arnica parryi	Nodding arnica		
2152	Arnica rydbergii	Rydberg's arnica	6	
2155	Arnica spp.	Genera		
2183	Aster alpigenus	Alpine aster	6	
2185	Aster chilensis ssp. adscendens	Long-leaved aster	1	B
2186	Aster conspicuus	Showy aster	1,6	B
2190	Aster foliaceus/parryi	Leafy aster	1,6	B
2200	Aster hesperius	Western willow aster	1	B
2202	Aster integrifolius	Thick-stemmed aster	6	
2205	Aster junciformis	Rush aster	2	C
2210	Aster laevis/geyeri	Smooth aster	1,2	B,C
2220	Aster modestus	Few-flowered aster	1	B
2225	Aster occidentalis	Mountain aster	2	C
2230	Aster pansus	White prairie aster	1	A,B
2235	Aster sibiricus	Arctic aster	6	
2240	Aster spp.	Genera		
2250	Astragalus adsurgens	Standing milk-vetch	3,4	A
2260	Astragalus alpinus	Alpine milk-vetch	6	
2263	Astragalus argophyllus/argophyllus	Silver-leaved milk-vetch	1	B
2270	Astragalus bisulcatus	Two-grooved milk-vetch	1,3,4	A,B
2272	Astragalus bourgovii	Bourgeau's milk-vetch	6	
2275	Astragalus canadensis	Canada milk-vetch	2	C
2280	Astragalus cibarius	Browse milk-vetch	1	B
2285	Astragalus crassicarpus	Ground plum		
2290	Astragalus drummondii	Drummond's milk-vetch	1,3,4	A,B
2295	Astragalus eucosmus	Elegant milk-vetch	6	
2300	Astragalus gilviflorus	Plains orophaca	1,3,4	A,B
2305	Astragalus misellus	Pauper milk-vetch	6	
2310	Astragalus miser	Weedy milk-vetch		A
2320	Astragalus missouriensis	Missouri milk-vetch		
2323	Astragalus purshii	Purshi's milk-vetch	1,6	B
2325	Astragalus robbinsii	Robbins' milk-vetch		
2329	Astragalus vexilliflexus	Bent-leaved milkvetch	6	
2330	Astragalus spp.	Genera		
2340	Bahia oppositifolia	Bahia	1	B
2350	Balsamorhiza incana	Hoary balsamroot	4	
2360	Balsamorhiza sagittata	Arrowleaf balsamroot	1,3,4,6	A,B
2370	Barbarea orthoceras	American wintercress	1	B
2380	Besseya wyomingensis	Wyoming besseya	3,4,6	A
2385	Boisduvalia glabella	Spike-primrose	2	C
2390	Bupleurum americanum	American thorough-wax	1,3,4,5	A,B
2395	Callitriche hermaphroditica	Northern water-starwort	2	C
2396	Callitriche heterophylla	Different-leaved water-starwort	2	C
2397	Calochortus gunnisonii	Sago lilly		
2398	Calypso bulbosa	Fairy slipper		
2400	Campanula rotundifolia	Scotch bluebell	1,2,3,4,5,6	A,B,C
2410	Capsella bursa-pastoris	Shepherd's-purse	1,2	B,C
2415	Carduus nutans	Musk thistle	3	A
2420	Carum carvi	Caraway	1,2	B,C

2430	Castilleja lutescens	Yellowish paintbrush	1,3,4	A,B
2440	Castilleja miniata/miniata	Common paintbrush	1,2	B,C
2445	Castilleja rhexifolia	Rhexia-leaved paintbrush	6	
2450	Castilleja sessiliflora	Downy painted-cup	1	B
2453	Castilleja sulphurea	Sulphur paintbrush	2	C
2455	Castilleja spp.	Genera		
2460	Centaurea maculosa	Spotted knapweed	1	A,B
2470	Cerastium arvense	Field chickweed	1,2,3,4,6	A,B,C
2480	Cerastium berringianum	Alpine chickweed	5,6	
2485	Cerastium vulgatum	Common chickweed	6	
2490	Cerastium spp.	Genera		
2500	Chenopodium album	Lambsquarter	1,2	B,C
2510	Chenopodium chenopodioides	Red goosefoot		
2520	Chenopodium fremontii/atrovirens	Fremont's goosefoot	1	B
2530	Chenopodium rubrum	Red goosefoot	1	B
2532	Chenopodium spp.	Genera		
2540	Chrysopsis villosa/foliosa	Hairy golden-aster	1,3,4	A,B
2550	Cicuta douglasii	Douglas' water-hemlock	1,2	B,C
2560	Cirsium arvense/horridum	Canadian thistle	1,2	B,C
2570	Cirsium scariosum	Elk thistle		
2580	Cirsium undulatum	Wavy-leaved thistle	1	B
2590	Cirsium vulgare	Bull thistle	1,2,4	A,B,C
2600	Cirsium spp.	Genera		
2610	Clematis hirsutissima	Douglas' clematis	1,3,4,6	A,B
2620	Claytonia lanceolata	Springbeauty		A
2630	Claytonia megarhiza	Alpine claytonia	6	A
2640	Collomia linearis	Narrow-leaf collomia	1,3,4	A,B
2650	Collinsia parviflora	Small-flowered blue-eyed Mary	3,4,6	A
2660	Comandra umbellata	Bastard toad-flax	1,3,4	A,B
2670	Conimitella williamsii	Williams conimitella	1	B
2680	Conringia orientalis	Hare's-ear mustard	1	B
2690	Convolvulus arvensis	Small bindweed	1	B
2692	Corallorhiza striata	Striped coral-root	2	C
2693	Corallorhiza trifida	Yellow coral-root	2	C
2700	Corydalis aurea	Golden corydalis		A
2710	Coryphantha vivipara	Cushion cactus	1	B
2720	Crepis acuminata	Long-leaved hawksbeard	1,4	B
2725	Crepis occidentalis	Western hawksbeard	3	A
2727	Crepis runcinata	Meadow hawksbeard	2	C
2730	Cruciferae spp.	Family		
2740	Cryptantha interrupta	Bristly cryptantha	1,3,4	A,B
2750	Cryptantha nubigena	Sierra cryptantha	1	B
2755	Cryptantha spp.	Genera		
2760	Cynoglossum officinale	Common hound's-tongue	1,2	B,C
2770	Cypripedium calceolus	Yellow lady's-slipper	2	A,C
2775	Cypripedium montanum	White lady's-slipper	2	C
2780	Descurainia pinnata	Western tansymustard	3,4	A
2790	Descurainia sophia	Flixweed	1	B
2800	Delphinium biocolor	Little larkspur		A
2810	Diplotaxis muralis	Wall rocket	1	B
2820	Disporum trachycarpum	Rough-fruited fairy-bell	1,2	A,B,C
2830	Dodecatheon conjugens	Slimpod shooting star	3	A
2840	Dodecatheon pulchellum	Few-flowered shooting star	2	C
2850	Douglasia montana	Rocky Mountain douglasia	1,3,4,6	A,B
2852	Draba lonchocarpa	Lancefruit draba	6	
2855	Draba nemorosa	Whitlow-wort	2	C
2860	Draba oligosperma/oligosperma	Few-seeded draba	1,6	B
2865	Draba oreibata	Limestone draba	6	
2867	Draba paysonii	Payson's draba	6	
2870	Draba reptans	Carolina whitlow-grass	3,4,6	A
2872	Draba spp.	Genera		
2873	Elatine americana	Mud-purslane	2	C
2874	Epilobium alpinum	Alpine fire-weed	6	
2875	Epilobium angustifolium	Fireweed	1,2,6	B,C
2880	Epilobium glandulosum	Common willow-weed	2,5	C
2885	Epilobium palustre	Swamp willow-weed	2	C

2890	Epilobium watsonii/watsonii	Watson's willow-weed	1,2	B,C
2900	Erigeron caespitosus	Tufted fleabane	1,4	B
2910	Erigeron compositus/glabratus	cut-leaved daisy	1,6	A,B
2912	Erigeron glabellus	Smooth daisy	2	C
2913	Erigeron grandiflorus	Large-flowered daisy	6	
2914	Erigeron humilis	Arctic-alpine daisy	6	
2916	Erigeron lanatus	Woolly daisy	6	
2917	Erigeron lonchophyllus	Short-rayed daisy	2	C
2920	Erigeron ochroleucus/ochroleucus	Buff fleabane	1,3,4	A,B
2923	Erigeron peregrinus	Subalpine daisy	6	
2925	Erigeron pumilis	Shaggy fleabane	6	
2928	Erigeron simplex	Alpine daisy	6	
2930	Erigeron speciosus/speciosus	Showy fleabane	1,2,3,4	A,B,C
2940	Erigeron spp.	Genera		
2950	Eriogonum flavum/flavum	Yellow buckwheat	1,3,4	A,B
2955	Eriogonum heracleoides	Wyeth buckwheat		
2960	Eriogonum mancum	Imperfect buckwheat		A
2970	Eriogonum ovalifolium/macropodum	Cushion buckwheat	1,6	B
2980	Eriogonum umbellatum/subalpinum	Sulphur buckwheat	1,6	B
2990	Eriogonum spp.	Genera		
2995	Eriophyllum lanatum	Wooly sunflower		
3000	Eritrichium howardii	Howard's alpine forget-me-not	3,4	A
3010	Eritrichium nanum	Pale alpine forget-me-not	A	
3020	Erodium cicutarium	Stork's-bill	1	B
3030	Erysimum asperum	Prairie rocket		A
3032	Erysimum cheiranthoides	Treacle mustard	2	C
3034	Erysimum repandum	Wallflower	2	C
3040	Erythronium grandiflorum	Glacier-lily	6	A
3050	Euphorbia esula	Spurge		A
3060	Fragaria virginiana/glauca	Blueleaf strawberry	1,2,3,4,5,6	A,B,C
3070	Frasera speciosa	Giant-frasera	4,6	
3080	Fritillaria pudica	Yellow bell	1	B
3090	Gaillardia aristata	Blanket-flower gaillardia	1,3,4	A,B
3095	Galium aparine	Goose-grass	2	C
3100	Galium boreale	Northern bedstraw	1,2,3,4,5,6	A,B,C
3105	Galium trifidum	Small bedstraw	2	C
3110	Galium triflorum	Fragrant bedstraw	1,6	A,B
3120	Gaura coccinea	Scarlet guara	1,3,4	A,B
3130	Gentiana affinis	Pleated gentian	1,2	A,B,C
3132	Gentiana amarella	Northern gentian	2	C
3140	Gentiana calycosa	Mountain bog gentian	5,6	
3150	Gentiana detonsa	Smaller fringed gentian	2	A,C
3155	Gentiana spp.	Genera		
3160	Geranium richardsonii	White geranium	1,2	A,B,C
3170	Geranium viscosissimum/ viscosissimum	Sticky geranium	1,3,4,6	A,B
3175	Geranium spp.	Genera		
3180	Geum aleppicum	Yellow avens	1,2	B,C
3190	Geum macrophyllum/macrophyllum	Large-leaved avens	1,2,4	B,C
3200	Geum triflorum/triflorum	Prairie smoke avens	1,3,4,6	A,B
3205	Glaux maritima	Saltwort	2	C
3210	Glycyrrhiza lepidota/lepidota	American licorice	1,2	A,B,C
3220	Goodyera oblongifolia	Western rattlesnake-plantain		A
3225	Gratiola ebracteata	Hedge-hyssop	2	C
3230	Grindelia squarrosa/quasiperennis	Curly-cup gumweed	1,2	A,B,C
3235	Guttierrezia sarothrae	Matchbrush	3,4	A
3240	Habenaria dilatata	White bog-orchid	1	B
3250	Habenaria hyperborea	Northern green bog-orchid	1,2	B,C
3255	Habenaria saccata	Slender bog-orchid	2	C
3257	Habenaria spp.			
3260	Habenaria unalascensis	Alaska bog-orchid		
3265	Habenaria viridis	Frog orchid	2	C
3270	Hackelia floribunda	Many-flowered stickseed	2,6	A,C
3280	Hackelia micrantha	Blue stickseed		
3285	Haplopappus integrifolius	Entire-leaved goldenweed	2	C

3287	Haplopappus lyallii	Lyall's goldenweed	6	
3290	Hedysarum alpinum	Alpine hedysarum	5	
3300	Hedysarum boreale/cinerascens	Northern hedysarum	1	A,B
3305	Hedysarum spp.	Genera		
3310	Hedysarum sulphurescens	Yellow hedysarum	1,3,4,5	A,B
3315	Helianthella uniflora	Rocky Mtn. helianthella		
3320	Helianthus annuus	Common sunflower	1	B
3330	Helianthus nuttallii/nutallii	Nutall's sunflower	1,2	B,C
3340	Helianthus rigidus/subrhomboideus	Showy sunflower	1	B
3342	Helianthus spp.	Genera		
3350	Heracleum lanatum	Cow-parsnip	1,2,6	A,B,C
3360	Heuchera cylindrica/glabella	Roundleaf alumroot	1,3,4	A,B,
3370	Heuchera parvifolia/dissecta	Common alumroot	1,6	A,B
3375	Heuchera spp.	Genera		
3377	Hieracium cynoglossoides	Hounds-tongue hawkweed	6	
3380	Hieracium gracile	Alpine hawkweed		A
3390	Hieracium umbellatum	Narrow-leaved hawkweed	2	C
3395	Hieracium spp.	Genera		
3398	Hippuris vulgaris	Mare's-tail	2	C
3400	Hydrophyllum capitatum	Ballhead waterleaf	6	A
3410	Hymenopappus filifolius/ polycephalus	Cut-leaved hymenopappus	1	B
3420	Hymenoxys acaulis/acaulis	Stemless hymenoxys	1,3,4	A,B
3430	Hymenoxys richardsonii/richardsonii	Richardson's hymenoxys	1	B
3435	Hypericum formosum	Western St. John's-wort	6	
3440	Iliamna rivularis/rivularis	Streambank globemallow	1,2	B,C
3450	Iris missouriensis	Rocky Mountain iris	1,2,3,4	A,B,C
3455	Iva axillaris	Poverty weed	2	C
3460	Ivesia gordonii	Gordon's ivesia		A
3470	Kelseya uniflora	Kelseya		A
3480	Lactuca pulchella	Blue lettuce	1	B
3490	Lactuca serriola	Prickly lettuce	1	B
3500	Lappula redowskii/redowskii	Western stickseed	1	B
3510	Lathyrus ochroleucus	Cream-flowered peavine	1,2	B,C
3515	Lathyrus spp.	Genera		
3518	Leguminosae	Family		
3520	Lepidium campestre	Field pepperweed	1	B
3530	Lesquerella alpina	Alpine bladderpod	1,3,4	A,B
3540	Liatrus punctata	Blazing-star	1,3,4	A,B
3545	Ligusticum spp.	Licorice root		
3546	Ligusticum verticillatum	Verticillate-umbel lovage		
3550	Lilium philadelphicum	Wood lily	2,3	A,C
3555	Limosella aquatica	Mudwort	2	C
3560	Linum perenne/lewisii	Wild blue flax	1,3,4,6	A,B
3570	Linum rigidum	Yellow flax	1	B
3580	Lithospermum ruderale	Western gromwell	1,3,4,6	A,B
3585	Lobelia kalmii	Bog lobelia	2	C
3590	Lomatium cous	Cous biscuit-root	6	
3600	Lomatium dissectum/multifidum	Fern-leaved lomatium	1,3,6	A,B
3610	Lomatium macrocarpum	Large-leaved lomatium	1,3,4	A,B
3620	Lomatium triternatum spp. platycarpum	Nine-leaf lomatium	1,6	A,B
3625	Lomatium spp.	Genera		
3630	Lupinus sericeus/sericeus	Silky lupine	1,3,4	A,B
3640	Lychnis apetala	Apet campion		
3650	Lysimachia ciliata	Fringed loosestrife	2	C
3655	Lysimachia thrysiflora	Tufted loosestrife	2	C
3660	Madia spp.		Tarweed	
3670	Medicago lupulina	Black medic	1,2	B,C
3680	Medicago sativa	Alfalfa	1	B
3690	Melilotus alba	White sweet-clover	1	B
3700	Melilotus officinalis	Yellow sweet-clover	1,2,3,4	A,B,C
3710	Mentha arvensis/glabrata	Field mint	1,2	B,C
3720	Mentzelia laevicaulis/laevicaulis	Blazing-star mentzelia	1	B
3725	Menyanthes trifoliata	Bogbean	2	C
3730	Mertensia ciliata/ciliata	Broad-leaf bluebells		

3733	Mertensia longiflora	Small bluebells	6	
3735	Mertensia oblongifolia	Leafy bluebells	6	
3740	Microseris cuspidata	Toothed microseris		A
3750	Microseris spp.	Genera		
3760	Mimulus guttatus/guttatus	Yellow monkey-flower	1	B
3765	Mitella breweri	Brewer's mitrewort	6	
3770	Monarada fistulosa/menthifolia	Horse mint	1,2,3,4	A,B,C
3780	Monolepis nuttalliana	Patata	1,2	B,C
3790	Musineon divaricatum	Leafy musineon	1,4	B
3792	Myosotis arvensis	Forget-me-not	2	C
3795	Myosotis sylvatica	Wood forget-me-not	6	
3797	Myosurus minimus	Mouse-tail	2	C
3800	Myriophyllum spicatum/exalbescens	Spiked water-milfoil	1,2	B,C
3805	Navarretia intertexta	Neddle-leaf navarretia	2	C
3810	Oenothera caespitosa/caespitosa	Desert evening-primrose	1	B
3820	Oenothera flava	Long-tubed evening-primrose	1	B
3830	Oenothera strigosa	Common evening-primrose	1,2	B,C
3840	Onobrychis viciaefolia	Saintfoin	1	B
3845	Onosmodium molle	False groomwell	2	C
3850	Opuntia polyacantha	Prickly-pear cactus	1,3,4	A,B
3860	Orthocarpus luteus	Yellow owl-clover	3,4	A
3865	Orthocarpus tenuifolius	Thin-leaved owl-clover		
3870	Osmorhiza chilensis	Mountain sweet-cicely	1,2	B,C
3875	Osmorhiza depauperata	Blunt-fruited sweet-cicely	2	C
3880	Osmorhiza occidentalis	Western sweet-cicely	1,2,6	B,C
3890	Osmorhiza spp.	Genera		
3895	Oxytropis bessayi	Bessey's crazyweed		
3900	Oxytropis campestris/gracilis	Field crazyweed	1	B
3905	Oxytropis deflexa	Pendant-pod crazyweed	2	C
3910	Oxytropis lagopus	Rabbit-foot crazyweed		
3920	Oxytropis sericea/spicata	Silky crazyweed	1,3,4,6	A,B
3030	Oxytropis splendens	Showy crazyweed	1,3,4	A,B
3940	Oxytropis viscida	Sticky crazyweed	1,3,4	A,B
3942	Oxytropis spp.	Genera		
3945	Pachistima myrsinites	Myrtle boxwood		A
3950	Parnassia fimbriata/fimbriata	Fringed grass-of-parnassus	1,6	B
3960	Parnassia palustris	Northern grass-of-parnassus	2	A,C
3970	Paronychia sessiliflora	Whitlow wort	1,3,4	A,B
3975	Pastinaca sativa	Parsnip	2	C
3980	Pedicularis bracteosa	Bracted lousewort	6	A
3990	Pedicularis contorta/contorta	White coiled-beak lousewort	1,3,5,6	A,B
4000	Pedicularis groenlandica	Elephant's head	6	A
4010	Pedicularis racemosa	Stickletop lousewort		A
4020	Pedicularis spp.	Genera		
4030	Penstemon albertinus	Alberta penstemon	1,3	A,B
4035	Penstemon attenuatus	Sulphur penstemon	6	
4040	Penstemon confertus	Yellow penstemon	1,3,4,5	A,B
4050	Penstemon ellipticus	Elliptic-leaved penstemon	5	
4060	Penstemon eriantherus/eriantherus	Fuzzy tongue penstemon	1,3,4,6	A,B
4065	Penstemon fruticosus	Shrubby penstemon	6	
4067	Penstemon lyallii	Lyall's beard tongue	6	
4070	Penstemon nitidus/nitidus	Shining penstemon	1,6	B
4080	Penstemon procerus/procerus	Small-flowered penstemon	1,2	B,C
4090	Penstemon spp.	Genera		
4100	Perideridia gairdneri ssp. borealis	Garidner's yampah	1,3,4	A,B
4110	Petalostemon candidum	White prairie-clover	1,4	B
4120	Petalostemon purpureum	Purple prairie-clover	1,3,4	A,B
4130	Phacelia sericea	Silky phacelia		A
4140	Phacelia hastata/alpina	Virgate phacelia	1,5,6	B
4150	Phacelia linearis	Threadleaf phacelia	3,4	A
4152	Phacelia lyalli	Lyall's phacelia		
4155	Phlox albomarginata	White-margined phlox	6	
4160	Phlox alyssifolia	Alyssum-leaved phlox	1,3,4	A,B
4170	Phlox hoodii	Hood's phlox	3,4	A
4175	Phlox kelseyi	Kelsey's phlox	2	C
4178	Phlox spp.	Genera		
4180	Physaria didymocarpa	Common twinpod	1,5,6	B

4185	Plagiobothrys scouleri	Popcorn-flower	2	C
4190	Plantago eriopoda	Alkali plantain	2	C
4195	Plantago major/major	Common plantain	1,2	B,C
4198	Polemonium occidentale	Western polemonium	6	
4200	Polemonium pulcherrimum	Showy polemonium	6	A
4210	Polygonum achoreum	Striated knotweed	1	B
4220	Polygonum amphibium	Water smartweed	1,2	B,C
4225	Polygonum aviculare	Doorweed	2	C
4230	Polygonum bistortoides	American bistort	1,3,6	A,B
4232	Polygonum convolvulus	Black bindweed	2	C
4235	Polygonum kelloggii	Kellog's knotweed	2	C
4236	Potamogeton crispus	Curled pondweed	2	C
4237	Potamogeton filiformis	Slender-leaved pondweed	2	C
4238	Potamogeton nodosus	Long-leaved pondweed	2	C
4239	Potamogeton pectinatus	Fennel-leaved pondweed	2	C
4240	Potentilla anserina	Common silverweed	1,2	B,C
4250	Potentilla arguta/convallaria	Glandular cinquefoil	1	A,B
4260	Potentilla diversifolia/ diversifolia	Diverse-leaved cinquefoil	1,6	B
4270	Potentilla glandulosa	Sticky cinquefoil	1	A,B
4280	Potentilla gracilis/glabrata	Slender cinquefoil	2,3,4,6	A,C
4281	Potentilla gracilis/flabelliformis	Slender cinquefoil	2,3,4	A,C
4290	Potentilla hippiana	Woolly cinquefoil	1,3,4	A,B
4300	Potentilla ovina	Sheep cinquefoil	6	
4310	Potentilla pensylvanica	Prairie cinquefoil	1	B
4320	Potentilla rivalis	River cinquefoil	1,2	B,C
4325	Potentilla uniflora	One-flower cinquefoil	5	
4330	Potentilla spp.	Genera		
4331	Primula incana	Mealy primrose	2	C
4335	Prunella vulgaris	Self-heal	2	C
4331	Pyrola asarifolia	Pink wintergreen	2	C
4340	Pyrola chlorantha	Wintergreen		A
4345	Phrola minor	Snowline wintergreen		
4350	Pyrola secunda	One-sided wintergreen		A
4360	Pyrola uniflora	Wax-flower		A
4370	Pyrola spp.	Genera		
4380	Ranunculus acriformis/montanensis	Sharp buttercup	1	B
4390	Ranunculus aquatilis/capillaceus	White water-buttercup	1,2	B,C
4400	Ranunculus cymbalaria	Shore buttercup	1,2	B,C
4410	Ranunculus eschscholtzii	Subalpine buttercup	6	A
4415	Ranunculus flammula	Creeping buttercup	2	C
4416	Ranunculus glabberimus	Sagebrush buttercup	6	
4417	Ranunculus gmelinii	Gmelin's buttercup	2	C
4420	Ranunculus macounii/macounii	Macoun's buttercup	1,2	B,C
4430	Ranunculus orthorhynchus	Straightbeak buttercup	1	B
4440	Ranunculus sceleratus/multifidus	Celeryleaved buttercup	1,2	B,C
4450	Ranunculus spp.	Genera		
4460	Ratibida columnifera	Prairie coneflower	1	B
4465	Rorippa islandica	Marsh yellowcress	2	C
4470	Rudbeckia laciniata/ampla	Tall coneflower	1,2	B,C
4480	Rumex crispus	Curly dock	1,2	B,C
4485	Rumex salicifolius	Willow dock	2	C
4490	Ruppia maritima	Seaside arrowgrass	1	B
4500	Sagittaria cuneata	Arrowhead	2	C
4505	Salsola kali	Russian thistle	1	B
4510	Sanicula marilandica	Black snake-root	1,2	A,B,C
4520	Saxifraga bronchialis/austromontana	Spotted saxifrage	1,6	B
4523	Saxifraga oppositifolia	Purple saxifrage	6	
4525	Saxifraga rhomboidea	Diamond-leaved saxifrage	6	
4530	Sedum lanceolatum/lanceolatum	Lance leaved stonecrop	1,3,4,6	A,B
4535	Sedum roseum	Roseroot	6	
4540	Sedum stenopetalum	Wormleaf stonecrop		A
4550	Sedum spp.	Genera		
4560	Senecio canus	Woolly groundsel	1,4	B
4570	Senecio fremontii	Dwarf mountain butterweed		A
4580	Senecio indecorus	Rayless mountain butterweed		

4581	Senecio integerrimus	Western groundsel	6	
4590	Senecio megacephalus	Large-headed butterweed		A
4600	Senecio pauperculus	Balsam goundsel	2	A,C
4610	Senecio pseudaureus/pseudaureus	Streambank butterweed	1	B
4615	Senecio resedifolius	Dwarf arctic butterweed	6	
4620	Senecio serra/serra	Butterweed groundsel	1,2	B,C
4630	Senecio spp.	Genera		
4640	Senecio triangularis/trianyularis	Arrowleaf groundsel	1,6	A,B
4642	Sibbaldia procumbens	Sibbaldia	6	
4643	Silene acaulis	Moss campion	6	
4645	Silene menziesii	Silene	2	C
4650	Sisymbrium altissimum	Tumblemustard	1	B
4660	Sisyrinchium angustifolium	Common blue-eyed grass	1,2	A,B,C
4665	Smelowskia calycina	Alpine smelowskia	6	
4670	Smilacina racemosa	Feather solomon's seal	1,2,3,4,6	A,B,C
4680	Smilacina stellata	Starry false solomon's seal	1,2	A,B,C
4690	Solidago canadensis/salebrosa	Canada goldenrod	1,2	B,C
4700	Solidago gigantea/serotina	Smooth goldenrod	1,2	B,C
4710	Solidago missouriensis/ missouriensis	Missouri goldenrod	1,3,4	A,B
4720	Solidago multiradiata	Northern goldenrod	5,6	
4725	Solidago Nemoralis	Gray goldenrod	2	C
4730	Solidago rigida/humilis	Stiff goldenrod	1	B
4737	Solidago spathulata	Dune goldenrod	6	
4740	Solidago spp.	Genera		
4750	Sonchus asper	Prickly sow-thistle	1	A,B,
4752	Sonchus uliginosus	Sow-thistle	2	C
4755	Sparganium emersum	Simple stem bur-reed	2	C
4757	Sparganium minimum	Small bur-reed	2	C
4760	Sphaeralcea coccinea	Red globe-mallow	1	B
4770	Spiranthes romanzoffiana	Ladies-tresses	2	A,C
4780	Stachys palustris/pilosa	Swamp hedge-nettle	1,2	B,C
4785	Stellaria longifolia	Longleaved starwort	2	C
4786	Stellaria media	Chickweed .	2	C
4790	Streptopus amplexifolius/chalazatus	Large twisted-stalk	1,2	B,C
4798	Taraxacum laevigatum	Red-seeded dandelion	2	C
4800	Taraxacum officinale	Common dandelion	1,2,3,4,6	A,B,C
4810	Taraxacum spp.	Genera		
4820	Thalictrum occidentale	Western meadowrue	1,2,3,4,6	A,B,C
4823	Thalictrum venulosum	Veiny meadowrue	2	C
4830	Thelesperma subnudum/marginatum	Thelesperma	2,3,4	A,B
4840	Thermopsis montana	Mountain thermopsis		
4850	Thermopsis rhombifolia	Round-leaved thermopsis	1,3,4	A,B
4860	Thlaspi arvense	Field pennycress	1,2	B,C
4870	Townsendia montana	Mountain townsendia		A
4880	Townsendia parryi	Parry's townsendia	1,6	B
4890	Tragopogon dubius	Yellow salsify	1,3,4	A,B
4895	Trifolium hybridum	Alsike clover	3	A
4898	Trifolium longipes	Long-stalked clover	2	C
4900	Trifolium pratense	Red clover	1,2,3,4	A,B,C
4910	Trifolium repens	White clover	1,2,3,4	A,B,C
4915	Trifolium spp.	Genera		
4920	Triglochin maritimum	Seaside arrow-grass	1,2,3,4	A,B,C
4925	Triglochin palustre	Marsh arrow-grass	2	C
4930	Trillium ovatum	Western wake-robin		
4950	Urtica dioica ssp. gracilis/ gracilis	Slim nettle	1,2	B,C
4960	Urtica dioica ssp. gracilis/procera	Stinging nettle	1,2	B,C
4965	Utricularia minor	Lessor bladderwort	2	C
4968	Utricularia vulgaris	Common bladderwort	2	C
4970	Unknown forb			
4980	Valeriana dioica	Northern valerian	2	A,C
4990	Valeriana edulis	Edible valerian	2	C
4995	Valeriana occidentalis	Western valerian		
5000	Valeriana sitchensis	Sitka valerian	6	A
5010	Valeriana spp.	Genera		
5020	Veratrum viride	Green false hellebore	6	A

5030	Verbena bracteata	Bracted verbena	1	B
5040	Veronica americana	American brookline	1,2	B,C
5043	Veronica catenata	Chain speedwell	2	C
5044	Veronica cusickii	Cusick's speedwell	6	
5047	Veronica peregrina	Purslane speedwell	2	C
5050	Vicia americana/truncata	American vetch	1,2,3,4	A,B,C
5060	Vicia sativa	Common vetch		
5065	Vicia spp.	Genera		
5068	Viola adunca	Early blue violet	2	A,C
5070	Viola canadensis/rugulosa	Western Canada violet	1,2,3	A,B,C
5080	Viola glabella	Stream violet		A
5085	Viola nephrophylla	Bog violet	2	C
5090	Viola orbiculata	Round-leaved violet		
5100	Viola spp.	Genera		
5110	Xanthium strumarium	Common cocklebur		
5115	Xerophyllum tenax	Beargrass		
5120	Zigadenus elegans	Mountain death-camas	1,2,3,4,5	A,B,C
5130	Zigadenus venenosus/gramineus	Meadow death-camas	1,3,4,6	A,B
5140	Zizia aptera/occidentalis	Zizia	1	B
5150	Total forbs			
5990	Moss			
6000	Mineral Soil			
6010	Rock			

Appendix C. Grizzly bears captured on the East Front, 1977-1986.

DATE OF CAPTURE	NO.	SEX	AGE AT CAPTURE	EAR TAG LOCATION	(TYPE)	FATE
5/04/77	257	F	8	Blackleaf	Orange/Yellow (metal)	Recaptured & radioed 6/13/80. Recaptured & radioed w/ helicopter in August, 1982.
5/07/77	110	F	2	Blackleaf	Red/Yellow (metal)	Recaptured 6/9/77, relocated, dead 1977.
5/25/77	271	M	5	Teton River	Blue/Yellow (metal)	Recaptured 5/20/78 & 5/9/79. Poached 1979.
6/08/77	273	F	3	Teton River	Yellow (metal)	Recaptured 5/16/81 & radioed. Illegally killed 9/23/84.
5/20/78	218	M	8	Teton River	Blue/Red (metal)	Radio nonfunctional, possibly alive.
5/29/78	531	M	3	Blackleaf	Silver/Orange (metal)	Relocated 1978 to Flathead.
6/16/78	282	M	2	Elk Cr.	Red (metal) & Green(rototag)	Recaptured & radioed 5/4/83. Hunter-kill 10/24/84.
6/17/78	229	M	9	Elk Cr./ Dearborn	Blue/Yellow (metal)	Hunter-kill 1979.
5/17/79	332	M	16	Elk Cr.	Red/Yellow (metal)	Relocated to British Columbia.
5/20/79	220	F	18	Teton area	Yellow/Blue (metal)	Recaptured 6/8/79 & 4/29/81 & reradioed w/helicopter in May 1983. Slipped collar at den site, winter 1984.
5/22/79	333	M	1	Blackleaf to Badger Cr.	Blue/Yellow (metal)	Recaptured 6/10/80 & 4/21/81. Lost collar in August 1982.
5/23/79	203	M	1	Teton area	Orange/Green (metal)	Sighted in 1981.
7/27/79	347	M	4	Dearborn area		Killed in 1980 by sheepherder.
5/14/80	348	M	4	Blackleaf	Silver/Red (metal)	Killed in 1980 by USFWS near Lincoln, Montana.
5/20/80	335	F	2	Blackleaf to Birch Cr.	Red/Orange (metal)	Recaptured 5/29/81 & radioed. Radio malfunctioned May 1984. Recaptured, radioed, & relocated, preventative action, to Elk Cr. 9/13/85.
6/10/80	291	F	3	Blackleaf	Red/Green (metal)	Fate unknown, radio nonfunctional.
8/14/80	223	M	5	Blackleaf to Badger Cr.	Yellow/Blue (metal)	Fate unknown, radio nonfunctional.
8/0?/80	430	F	2	Badger Cr.		Relocated & dead in 1980.
5/20/82	529	M	2	Teton to Sun River	Blue (rototag)	Recaptured & radioed 5/25/82. Hunter-kill 1982, at N. Fk. Sun River.
5/26/82	550	M	2	Blackleaf to Two Medicine	Blue (rototag)	Lost collar in July, 1982. Hunter-kill Sept. 1983, after relocation.
6/18/82	518	F	2	Teton to Deep Cr.	Red (rototag)	Ear-tag transmitter. Recaptured in 1983. Hunter-kill 10/21/84.
6/27/82	519	M	1	Teton area	Blue (rototag)	Hunter-kill 1982 at Teton River.
6/28/82	544	M	2	Teton area	Blue (rototag)	Radioed in 1982, still functional. Recaptured 1984, Killed illegally Sept. 1984.
8/17/82	548	F	10	Deep Cr.	Blue (rototag)	Captured & radioed w/helicopter, recaptured in 1983. Radio malfunctioned.
5/03/83	522	F	1	Pine Butte	Red (rototag)	Unknown fate.

5/27/83	524	F	1	Rinkers Cr.	Red (rototag)	Radioed w/ear-tag transmitter; 1983. Radio malfunctioned.
5/31/83	500 499	F	4	Teton River	Green (rototag)	Radioed. Helicopter darted, recaptured, radioed at depredation site 6/11/85, relocated to S. Fk. Flathead. Helicopter darted, recaptured at depredation site 6/29/85, relocated to E. side of Mission Mtns., returned. Radio malfunction 1986.
6/10/83	498 497	M	4	Willow Cr.	Green (rototag)	Radio malfunction spring 1985. Recaptured 6/23/86, trap/drug caused mortality..
7/10/83	485 484	M	7	Whiterock Creek	Green (rototag)	Radioed. Recaptured 6/26/84. Collar slipped approx. 7/1/85.
4/06/84	328	M	2	Teton	Green (rototag)	Radioed, recaptured 5/19/84. Lost collar returned,1987.
6/20/84	313	F	3	Two Medicine	Green (rototag)	Radioed, still operate 1985.
6/26/84	366	F	5	Two Medicine	Green (rototag)	Recaptured 7/6/86 and radioed. Radio functional 1988.
7/06/84	355	M	8	Two Medicine	Green (rototag)	Recaptured 5/23/86, 5/27/86, 6/21/86. Slipped collar 8/86. Hunter killed 1987.
8/23/84	378	M	2	Teton	Green (rototag)	Helicopter darted, radioed, recaptured 9/27/84 at depredation site relocated to S. Fk. Flathead.
9/10/84	317	F	2	Teton	Green (rototag)	Radioed, still operate 1985.
9/18/84	372	F	8	Alice Cr.	Green (rototag)	Radioed, relocated to S. Fk. Flathead - dead Oct. 1984 at Burdoff Cr. cause of death unknown.
9/18/84	343	M	1	Alice Cr./ Willow Cr.	Green (rototag)	Helicopter darted cub of 372 recaptured, radioed, at depredation site 6/29/85; capture mortality.
9/25/84	392	M	3	Teton	Green (rototag)	Radioed, still operate 1985.
10/02/84	326	M	1	Teton/Middle Fk. Dearborn	Green (rototag)	Radioed, collar slipped in November 1984. Recaptured & radioed 4/4/85. Recaptured & relocated, livestock depredation 8/3/85. Illegally killed 1985.
5/11/85	316	F	3	Cuniff Cr.	Green (rototag)	Radioed, recaptured 5/14/85. Captured and relocated,1987. Hunter killed,1987.
5/18/85	342	M	2	Fairfield Bench	Green (rototag)	Radioed & relocated, preventative action, to Middle Fk. Flathead. Recaptured at depredation site 6/1/85, transported to zoo, Mexico City.
5/23/85	346	M	6	Cuniff Cr.	Green (rototag)	Radioed. Collar slipped early Oct., 1985.
6/11/85	---	M	1	Deep Cr.	---	Helicopter darted at depredation site, capture mortality. Cub of 500 unmarked
6/11/85	338	M	1	Deep Cr.	Green (rototag)	Helicopter darted at depredation site, relocated to So. Fk. Flathead. Helicopter

						darted & recaptured at depredation site 6/29/85, relocated to E. side of Mission Mtns. returned. Cub of 500
6/11/85	341	F	1	Deep Cr.	Green (rototag)	Helicopter darted at depredation site, relocated to So. Fk. Flathead. Helicopter darted & recaptured at depredation site 6/29/85, relocated to E. side of Mission Mtns. returned. Recaptured at depredation site 5/14/86, transported to zoo, Detroit. Cub of 500.
6/17/85	301	F	12	Moudess Cr.	Green	Radioed.
9/13/85	306	M	1	Dupuyer Cr.	(rototag)	GreenRadioed & relocated, preventative action, to S. Fk. Flathead. Returned. Illegally killed late Oct., early Nov., 1985. Cub of 335
9/13/85	381	M	1	Dupuyer Cr.	Green (rototag)	Radioed & relocated, preventative action, to S. Fk. Flathead. Cub of 335 Survived in S.FK. Flathead.
9/13/85	312	F	2	Teton River	Green (rototag)	Radioed & relocated, preventative action, to Sun River Game Range. Returned.
5/16/86	101	F	3	Ford Cr.	Green (rototag)	Radioed, relocated, preventive action, killed illegally 1986.
5/20/86	410	M	3	Smith Cr.	Green (rototag)	Died of natural mortality 5/20/86.
5/21/86	412	M	7	Petty Cr.	Green (rototag)	Radioed. Slipped collar 7/86. Recaptured at depredation,1988 Management kill, 1988
6/28/86	464	F	Cub	Badger Cr.	Green (rototag)	Cub of 466.
6/28/86	466	F	15	Badger Cr.	Green (rototag)	Radio still functional,1988
7/6/86	467	M	3	Elbow Cr.	Green (rototag)	Radioed, recaptured 7/9/86. Illegally killed, 1987.
10/9/86	106	M	4	Teton area	Green (rototag)	Captured at depredation site and relocated. Illegally killed 10/86.
5/28/86	107	M	1	Sheep Crk.	Yellow (rototag)	Relocated but returned. Radio operating 1988.
5/28/87	108	M	1	Sheep Crk.	Yellow (rototag)	Relocated and returned. Recaptured-mgmt.killed,1987
6/1/87	109	M	1	Dupuyer Crk.	Yellow (rototag)	Not collared. Relocated w/110. Unknown fate.
6/2/87	110	M	1	Dupuyer Crk.	Yellow (rototag)	Captured and relocated. Recaptured near Helmville and relocated. Returned to E. Front. Illegally killed,1987.
10/2/87	117	M	1	Teton	Yellow (rototag)	Captured and relocated,1987.

Appendix D. Black bears captured on the East Front, 1976-1986.

DATE OF CAPTURE	NO.	SEX	AGE AT CAPTURE	LOCATION	EAR TAG (TYPE)	COLOR	FATE
9/15/76	190	F	7	Badger Cr.	Blue/Green (metal)	Black	Recaptured 6/27/77.
9/20/76	153	F	Adult	Badger Cr.	Red/Green (metal)	Black	Recaptured 10/16/76.
10/01/76	150	M	Adult	Badger Cr.	Red/Blue (metal)	Black	Unknown.
10/02/76	2	M	Adult	Badger Cr.	Yellow (metal)	Black	Unknown.
10/07/76	3	M	2	Badger Cr.	Yellow (metal)	Brown	Unknown.
4/30/77	117	M	5	Dupuyer Cr.	Yellow/Blue (metal)	Black	Recaptured 5/3/77.
5/09/77	173	M	3	Dupuyer Cr.	Yellow/Blue (metal)	Black	Unknown.
5/09/77	262	M	9	Dupuyer Cr.	Yellow/Orange (metal)	Brown	Recaptured 6/3/78.
5/22/77	207	F	-	Teton River	Blue/Orange (metal)	Brown	Unknown.
5/23/77	201	M	2	Teton River	Orange (metal)	Black	Hunter-kill 1980.
5/27/77	265	M	4	Teton River	Blue/Yellow (metal)	Brown	Recaptured 5/10/78. Hunter-kill 1980.
6/05/77	274	M	2	Teton River	Yellow/Blue (metal)	Black	Hunter-killed 10/2/87
6/08/77	209	F	18	Teton River	Orange/Silver (metal)	Brown	Unknown.
6/19/77	213	M	2	Badger Cr.	Blue/Green (metal)	Black	Unknown.
6/25/77	219	M	8	Badger Cr.	Blue/Green (metal)	Black	Recaptured 6/28/77.
6/26/77	204	M	2	Badger Cr.	Orange/Silver (metal)	Black	Unknown.
5/10/78	256	M	5	Teton River	Orange/Red (metal)	Brown	Hunter-kill 6/3/79.
5/12/78	211	M	11	Teton River	Yellow/Orange (metal)	Black	Relocated to Blackleaf 8/21/80.
6/06/78	212	M	3	Blackleaf	Blue/Red (metal)	Black	Recaptured 9/25/80 & 6/23/81 & radioed. Recaptured 5/24/82. Hunter-kill 7/11/82.
6/13/78	202	M	7	Elk Cr.	Orange/Blue (metal)	Brown	Recaptured 5/2/84 @ Elk Cr. Hunter-kill 9/25/86.
6/14/78	205	M	Adult	Elk Cr.	Orange/Red (metal)	Black	Unknown.
5/20/79	288	M	10	Blackleaf	Green/Red (metal)	Brown	Recaptured 5/10/80 & 6/29/82 & radioed. Radio off Sept. 1982.
5/28/79	255	F	3	Teton River	Orange/Silver (metal)	Brown	Recaptured 5/16/82.
6/09/79	115	M	7	Teton River	Yellow/Green (metal)	Brown	Unknown.
6/09/79	294	M	6	Teton River	Green/Orange (metal)	Black	Recaptured 5/23/82. Hunter-kill 5/23/82.
5/19/80	329	M	3	Blackleaf	Yellow/Red (metal)	Black	Hunter-kill 8/6/80 @ Cave Mtn.
5/21/80	223	M	2	Blackleaf	Blue (rototag)	Brown	Unknown.
5/28/80	538	M	2	Blackleaf	Blue (rototag)	Brown	Hunter-kill June 83 @ Ford Cr.
5/30/80	505	M	2	Blackleaf	Red (rototag)	Black	Recaptured 9/1/80.

Appendix D. Black bears captured on the East Front, 1976-1986, (continued).

DATE OF CAPTURE	NO.	SEX	AGE AT CAPTURE	LOCATION	EAR TAG (TYPE)	COLOR	FATE
6/07/80	542	M	3	Blackleaf	Blue (rototag)	Black	Hunter-kill 10/28/82 @ Green Timber Gulch.
6/09/80	509	F	9	Blackleaf	Red (rototag)	Black	Recaptured 5/14/81 & radioed; observed 8/22/84.
5/20/81	545	F	3	Blackleaf	Blue (rototag)	Black	Recaptured 5/21/81.
5/23/81	546	F	3	Blackleaf	Blue (rototag)	Brown	Hunter-killed 5//87
5/27/81	516	M	2	Blackleaf	Red (rototag)	Brown	Unknown.
5/02/82	539	M	2	Teton River	Blue (rototag)	Brown	Hunter-kill 11/3/83 Patricks Basin.
5/17/82	513	M	2	Teton River	Red (rototag)	Brown	Recaptured 6/19/83, 5/17/84 at Sun River Game Range.
5/17/82	514	M	2	Teton River	Red (rototag)	Brown	Recaptured 6/26/82. Hunter-kill 10/2/82 @ Jones Cr.
5/22/82	531	F	4	Dupuyer Cr.	Blue (rototag)	Black	Hunter kill 9/28/86.
6/19/82	523	F	6	Teton River	Red (rototag)	Black	Radioed until 5/25/84 when collar was cast.
6/24/82	517	M	4	Teton River	Red (rototag)	Black	Radioed. Recaptured May, 1983, collar dead. Hunter-kill 5/18/85 @ Reirdon Gulch.
7/12/82	533	F	8	Badger Cr.	Blue (rototag)	Brown	Hunter-kill 10/19/83 @ Badger Cr.
4/30/83	530 354	M	6	Blubber Cr.	Blue/Green (rototag)	Brown	Recaptured 5/27/83, 5/4/84, renumbered 354 on 6/3/84, recaptured 5/17/86. Hunter-kill 5/25/86.
4/30/83	535 365	M	4	Blubber Cr.	Blue/Green (rototag)	Black	Recaptured 6/17/83,5/12/84 Hunter-killed 5/15/85.
5/18/83	536	M	10	Blubber Cr.	Blue (rototag)	Black	Recaptured 5/27/83 & 6/15/83, 5/12/84.
5/19/83	506	M	4	Pine Butte	Red (rototag)	Black	Radioed. Hunter-kill Sept. 1984 @ Jones Creek.
5/24/83	515	M	4	Rinkers Cr.	Red (rototag)	Black	Radioed until 5/11/84, collar dead. Hunter-kill 8/11/85 @ Jones Cr.
5/27/83	537	M	2	Blubber Cr.	Blue (rototag)	Black	Unknown.
6/11/83	532	M	4	Willow Cr.	Blue (rototag)	Black	Hunter-kill 5/21/84 @ Ford Cr.
6/12/83	525	F	4	Blubber Cr.	Red (rototag)	Black	Recaptured 5/25/86.
6/13/83	534	M	3	Sun River Game Range	Blue (rototag)	Black	Recaptured 6/27/83, 5/11/84.
6/16/83	478	M	2	Sun River Game Range	Green (rototag)	Black	Hunter killed 5/21/86, tatoo id.?
6/17/83	479	F	1	Beaver Cr.	Green (rototag)	Black	Unknown.
[1]6/18/83	520	M	2	Blubber Cr.	Red (rototag)	Black	Unknown.
6/20/83	507	M	1	Blubber Cr.	Red (rototag)	Black	Recaptured 6/22/83, 5/17/84.
6/21/83	477/ 409	F	10	Willow Cr.	Green (rototag)	Brown	Recaptured 5/21/86 & renumbered 409.

Appendix D. Black bears captured on the East Front, 1976-1986, (continued).

DATE OF CAPTURE	NO.	SEX	AGE AT CAPTURE	LOCATION	EAR TAG (TYPE)	COLOR	FATE
6/25/83	491	F	2	Beaver Cr.	Green (rototag)	Black	Unknown.
6/25/83	492	M	5	Beaver Cr.	Green (rototag)	Brown	Hunter-kill 5/27/85 @ Farview Cr.
6/27/83	494	F	10	Rose Cr.	Green (rototag)	Black	Unknown.
6/27/83	476	M	3	Willow Cr.	Green (rototag)	Black	Unknown.
[1] 7/12/83	520	M	3	N. Fk. Badger Cr.	Red (rototag)	Cinnamon	Recaptured 5/26/86. Hunter-killed 5/18/88
7/12/83	547	M	5	Whiterock	Blue (rototag)	Black	Recaptured 6/4/84. Hunter-kill September 1984 @ Badger Cr.
8/05/83	401/ 426	F	4	S. Fk. Teton	Green (rototag)	Black	Nuisance bear captured @ Circle 8. Nuisance bear recaptured 8/30/86, renumbered 426.

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[1] Two black bears inadvertantly #'d the same - one is cinnamon and one is black.

Appendix D. Black bears captured on the East Front, 1976-86, (continued).

DATE OF CAPTURE	NO.	SEX	AGE (1986)	LOCATION	EAR TAG (TYPE)	COLOR	FATE
5/02/84	327/ 418	M	10	Willow Cr.	Green (rototag)	Brown	Recaptured 5/23/84, renumbered 418 on 6/27/86.
5/05/84	352	M	7	Beaver Cr.	Green (rototag)	Black	Recaptured 5/12/84 at Middle Fk. Beaver Ck. Hunter-kill 5/20/86.
5/07/84	455	M	2	Blubber Cr.	Green (rototag)	Cinnamon	Recaptured 5/28/84 Goss Ck.
5/08/84	353	M	2	Beaver Cr.	Green (rototag)	Cinnamon	Hunter-kill 5/22/86.
5/08/84	475	M	7	Elk Cr.	Green (rototag)	Black	Recaptured 5/11/84 at Sawmill Pass.
5/10/84	364	F	2	Sun River Game Range	Green (rototag)	Brown	Unknown.
5/10/84	339	M	9	Ford Cr.	Green (rototag)	Brown	Hunter-killed 4/22/87
5/10/84	344	M	1	Beaver Cr.	Green (rototag)	Blonde	Unknown.
5/12/84	332	M	2	Blubber Cr.	Green (rototag)	Cinnamon	Recaptured 5/18/84 at Sawmill Pass and 6/10/84 at Blubber Cr.
5/13/84	375	M	14	Sun River Game Range	Green (rototag)	Black	Unknown.
5/14/84	331	F	5	Willow Cr.	Green (rototag)	Brown	Recaptured 5/18/84 & 5/16/86.
5/18/84	495	M	2	Elk Cr.	Green (rototag)	Black	Hunter-kill 5/26/86.
5/19/84	388	M	2	Smith Cr.	Green (rototag)	Brown	Hunter-kill in October 1984 @ Elk Creek.
5/22/84	380	F	20	Shed Cr.	Green (rototag)	Cinnamon	Hunter-kill 6/1/85 @ Sun River Game Range.
5/22/84	387	M	1	Shed Cr.	Green (rototag)	Black	Unknown.
5/23/84	389	F	2	Beaver Cr.	Green (rototag)	Black	Unknown.
5/26/84	393	M	9	Elk Cr.	Green (rototag)	Black	Hunter-kill August 1984 @ Elk Cr.
6/02/84	383	M	3	Blubber Cr.	Green (rototag)	Black	Recaptured 6/4/84 at Sawmill Cr. and 6/13/84 at Goss Cr. Hunter-kill 10/15/86
6/03/84	399	M	4	Elk Cr.	Green (rototag)	Brown	Hunter-kill 10/19/84 @ Bighorn Lake.
6/04/84	318	M	2	Gross Cr.	Green (rototag)	Black	Unknown.
6/05/84	360	M	2	Hyde Cr.	Green (rototag)	Black	Unknown.
6/07/84	356	F	2	Mettler Coulee	Green (rototag)	Black	Recaptured 5/29/86.
6/09/84	345	F	4	Cyanide Cr.	Green (rototag)	Blonde	Hunter-kill 9/27/86.
6/11/84	336	F	8	Mettler Coulee	Green (rototag)	Black	Unknown.
6/19/84	322	M	5	Mettler Coulee	Green (rototag)	Cinnamon	Unknown.
6/19/84	386	F	2	Hyde Cr.	Green (rototag)	Black	Unknown.
6/24/84	349	M	13	Hyde Cr.	Green (rototag)	Black	Unknown.
6/25/84	348	M	2	Box Cr.	Green (rototag)	Black	Unknown.

Appendix D. Black bears captured on the East Front, 1976-86, (continued).

DATE OF CAPTURE	NO.	SEX	AGE (1986)	LOCATION	EAR TAG (TYPE)	COLOR	FATE
6/28/84	397	M	9	Mettler Coulee	Green (rototag)	Black	Unknown.
6/28/84	330	M	2	W. Fk. Sun River	Green (rototag)	Blonde	Recaptured 7/5/84. Hunter-kill July 1985 @ Moose Cr.
7/01/84	400	F	2	S. Fk. Sun River	Green (rototag)	Black	Hunter-kill 11/6/85 @ Bighead Cr.
7/03/84	390	M	12	W. Fk. Sun River	Green (rototag)	Brown	Recaptured 6/23/86 & 6/25/86.
8/26/84	376	M	2	Simms	Green (rototag)	Black	Relocated to SRGR. Hunter-kill 9/11/84 in Sun River Canyon.
10/07/84	340	M	2	Smith Cr.	Green (rototag)	Cinnamon	Relocated to Beartooth Game Range.
5/14/85	362	F	2	Poplar Cr.	Green (rototag)	Brown	Hunter-kill 10/29/85 @ Joslin Basin.
5/19/85	377	M	9	Cuniff Cr.	Green (rototag)	Black	Recaptured 5/16/85 @ Cuniff Cr. and 5/26/85 @ Big Skunk Cr.
5/19/85	337	M	3	Cuniff Cr.	Green (rototag)	Brown	Hunter-kill 9/28/86.
5/19/85	367	M	3	Cuniff Cr.	Green (rototag)	Brown	Unknown.
5/25/85	370	M	3	Cuniff Cr.	Green (rototag)	Black	Hunter-kill 9/6/85 @ Falls Cr.
5/28/85	334	F	13	Cuniff Cr.	Green (rototag)	Brown	Unknown.
5/29/85	351	M	8	Cuniff Cr.	Green (rototag)	Black	Unknown.
6/11/85	304	M	9	Moudess Cr.	Green (rototag)	Brown	Recaptured 6/18/85 @ Moudess Cr. Hunter-killed 9/87
6/20/85	303	M	8	Dearborn River	Green (rototag)	Brown	Unknown.
6/21/85	309	M	7	Dearborn River	Green (rototag)	Black	Recaptured 5/23/86 @ Smith Cr.
6/23/85	311	M	4	Moudess Cr.	Green (rototag)	Black	Recaptured 5/17/86 @ Smith Cr.
5/15/86	407	M	3	Smith Cr.	Green (rototag)	Brown	Unknown.
5/16/86	403	M	6	Willow Cr.	Green (rototag)	Black	Unknown.
5/16/86	405	F	4	Smith Cr.	Green (rototag)	Black	Hunter-kill 5/16/86.
5/18/86	459	M	4	Badger Cr.	Green (rototag)	Brown	Recaptured 5/23/86, 6/2/86.
5/19/86	406	M	3	Smith Cr.	Green (rototag)	Brown	Unknown.
5/20/86	408	M	4	Willow Cr.	Green (rototag)	Brown	Unknown.
5/21/86	404	F	1	Ford Cr.	Green (rototag)	Blonde	Unknown.
5/21/86	473	M	4	Badger Cr.	Green (rototag)	Brown	Recaptured 6/1/86.
5/24/86	413	M	2	Willow Cr.	Green (rototag)	Black	Unknown.
5/24/86	414	M	1	Willow Cr.	Green (rototag)	Brown	Unknown.
5/25/86	458	M	2	Badger Cr.	Green (rototag)	Black	Hunter-kill 10/8/86.

Appendix D. Black bears captured on the East Front, 1976-86, (continued).

DATE OF CAPTURE	NO.	SEX	AGE (1986)	LOCATION	EAR TAG (TYPE)	COLOR	FATE
5/26/86	415	M	1	Ford Cr.	Green (rototag)	Brown	Unknown.
5/27/86	416	M	3	Petty Cr.	Green (rototag)	Brown	Unknown.
5/28/86	457	F	12	Badger Cr.	Green (rototag)	Black	Unknown.
5/29/86	461	M	6	Badger Cr.	Green (rototag)	Black	Unknown.
6/12/86	472	M	3	Badger Cr.	Green (rototag)	Black	Unknown.
6/17/86	468	M	3	Muskrat Cr.	Green (rototag)	Brown	Unknown.
6/19/86	462	M	Sub-Adult	Badger Cr.	Green (rototag)	Brown	Unknown.
6/23/86	417	F	7	Fairview Cr.	Green (rototag)	Black	Hunter-kill 8/2/86.
6/23/86	471	F	9	Kip Cr.	Green (rototag)	Black	Unknown.
6/28/86	469	M	6	Kip Cr.	Green (rototag)	Brown	Unknown.
6/28/86	474	M	3	Muskrat Cr.	Green (rototag)	Brown	Unknown
6/29/86	463	M	9	Crucifixion Cr.	Green (rototag)	Black	Unknown.
7/10/86	482	F	3	Badger Cr.	Green (rototag)	Brown	Unknown.
8/30/86	102	M	3	Teton River	Yellow (rototag)	Brown	Relocated to Whiterock Pass.
8/30/86	103	F	Cub	Teton River	Yellow (rototag)	Cinnamon	Relocated to Whiterock Pass.
8/30/86	104	M	Cub	Teton River	Yellow (rototag)	Black	Relocated to Whiterock Pass.
9/6/86	437	M	10	Windfall Cr.	Green (rototag)	Brown	Recaptured 9/9/86 Hunter-kill 9/21/86.
9/7/86	428	F	16	Lange Cr.	Green (rototag)	Black	Unknown.
9/10/86	427	M	8	Windfall Cr.	Green (rototag)	Brown	Unknown.
9/11/86	105	F	13	Sun River	Yellow (rototag)	Black	Hunter-kill 10/4/86.
9/12/86	434	M	4	Windfall Cr.	Green (rototag)	Brown	Unknown.

Appendix E. Case studies conducted during seismic survey operations 1983-87.

Case 1

During August 18 and 19 two radio collared adult female bears (220 and 335) were monitored while seismic operations were conducted on lines three and 7. Bear 220 had an activity collar while bear 335 did not. During a two hour monitoring session from 11:00 a.m. to 1:00 p.m. both bears were monitored from a vehicle positioned on a bench above Cow Creek. Both bears were located early in the morning during a radio relocation flight. Both were inactive and bedded when first contacted on the ground. Bear 220 showed an increased activity level when the vehicle from which we monitored these bears was first positioned. Also a vehicle left the section 5 well site during the initial phase of this monitoring period. Bear 220 was about 200 m. from the well site and about 200 m. from our position. Bear 335 was about 150 m. from our position and 250 m. from section 5 well site on Cow Creek. During the two hour monitoring period some low level helicopter flights to and from the LZ produced moderate noise levels almost continuously for the two hour period. A total of 17 seismic charges on the surface were exploded. The sound from these charges varied from a low muffled sound to a loud reverberating sound. During this period of monitoring no response in bear 220's activity collar was recorded excluding the initial response to our own truck. During the course of the period both bears did not change position even though exposed to low level helicopter noise from 1.6 km distance, seismic blasts from 6.4 km, and three vehicle trips into section 5 well only 200 m. distance.

At 4:30 p.m. the evening of August 18 monitoring of these bears continued. Seismic operations were shut down for the day and no maintenance personnel were present at the section 5 well. Bear 220 became active shortly after 4:30 p.m. while bear 335 did not begin to move until 5:55 p.m.. During the night both bears roamed freely on Cow Creek and adjacent habitats. Bear 220 went to a cow carcass she had fed on the day before. Bear 335 wandered as if looking for berries along Cow Creek. Bear 335 and 220 fought over the cow carcass at 5:45 a.m. Bear 220 moved back to the same day bed used August 18 by 7:30 a.m. while bear 335 went to a new location and dug a day bed. She became inactive by 8:45 a.m. Seismic activity began at 8:10 a.m. but was located far to the south of yesterdays operation. Noise levels from helicopters and blasts were minimal. At 8:20 a.m. a fixed wing aircraft flew less than 50 m. over bear 220's bed. The activity collar indicated increased activity by the bear in response to this fly over. The fly over lasted only about ten seconds but increased activity response by the bear lasted ten minutes. It was not until 8:30 a.m. that bear 220 became inactive again. Monitoring ceased at 9:30 a.m. on August 19.

In summary the bears monitored showed no response to seismic activities conducted 6.4 km from their location. These individuals did not respond to helicopter activity near an LZ at 1.6 km from their location. However they did respond to vehicle noise at 200 m. of their location and to a fixed wing fly over at 50 m. altitude. None of the above mentioned activities caused the bears to be displaced from midday bed sites in secure cover.

Case 2

During a radio tracking flight on August 22, 1983 bear 220 was located at the Antelope Butte Swamp in a day bed under dense aspen cover. A seismic survey was being conducted on the west end of line 7 (Figure 33). A helicopter flight line ran south of the bears location to an LZ on Blind Horse Creek about 3.2 km from the bears location. Seismic blasts could be heard about 5 km to the west of 220's location and helicopter activity was constant until 8:00 p.m. At 2:45 p.m. one helicopter flew over 220's day bed dropped a bucket from underneath the chopper and scooped water from a beaver pond 180 m. from the bears day bed. A ground crew went in at 6:20 p.m. to monitor bear 220 for the night. At 6:20 p.m. bear 220 was active but still very near her bed site. The bear traveled that evening heading N.E. perpendicular to the helicopter flight line and seismic line 7. The bear was observed watching a helicopter flying overhead about .2 km away. The bear came to an attention posture than resumed traveling after the helicopter passed. The bear traveled fairly constantly from 6:45 p.m. until 11:00 p.m. when she was approximately 5.6 km from her original location. The bear slowly moved up Cow Creek until 8:00 a.m. when monitoring discontinued due to a vehicle failure.

In summary bear 220 acknowledged helicopter flights associated with seismic exploration at .2 km distance. A low level fly over of 220's bed was experienced also. These activities did not cause the bear to leave a secure bed site in good cover. However, that evening the bear chose to leave the area traveling in a direction away from the day time activities of seismic exploration.

Case 3

Bears 220 and 335 were located during ground tracking efforts on August 24 in the S. Fork of Dupuyer. A seismic line had been surveyed up the bottom of the S. Fork Dupuyer. Seismic surveying was being conducted on line 7 about 5.6 km to the south. Blasting from surface charges and helicopter noise could be heard. Monitoring was conducted from 3:00 p.m. until 5:30 p.m. Both bears were inactive and bedded when first contacted. By 3:45 p.m. both bears became active and began feeding on buffalo berry prevalent in the area. The observer in this session observed one unmarked grizzly and five black bears in the drainage as well as grizzly 220 and 335. Bears observed did not seem to respond to about 20 blast from seismic work conducted on line 7, 5.6 km distance.

On August 25 bears 220 and 335 were located in the S. Fork of Dupuyer Creek during a radio relocation flight. A ground crew went in to monitor the bears at 3:30 p.m. Seismic work was still prevalent on line 7 to our south. One helicopter trip up into the canyon about 80 m. overhead of the bears was made. Both bears appeared to increase activity suggesting they were aware of the helicopter. Both bears became active by about 4:30 p.m. Monitoring of the bears continued until 10:00 p.m. Two grizzlies 200 and 335 plus five black bears were observed during this session.

On August 26 monitoring of bears continued at 2:00 a.m. Bear 220 had moved up on a ridge to dig Lomatium cous. Bear 335 was still active in the shrubfield burn feeding on buffalo berry. Bears roamed the canyon freely until 8:00 a.m. when 220 bedded and 9:00 a.m. when 335 bedded. At 8:15 a.m. helicopter noise could be heard to the east. Seismic work had begun on line 5 while finishing line 7. During the period from 8:20 a.m. until 7:00 p.m. a total of eight helicopter trips were made into the canyon. One crew was dropped off to finish staking the line. Bear 220 with an activity collar showed increased activity during all eight fly overs by helicopters but did not leave her secure bed site in heavy timber. Bear 335 recorded noticeable signal strength shifts with five of eight fly overs. Seismic blasts could be heard from line 7 and again bears showed no reaction to these blasts which are distant. Bears were monitored until 12:00 midnight. During the day both grizzlies had been observed as well as six different black bears.

On August 27 bears were monitored until 2:00 a.m. Then hourly checks were made until 6:00 a.m. when 335 could not be heard. Bear 335 had moved up the canyon then north into the adjacent drainage by 6:00 a.m. We did not relocate her until 36 hours later when she was found during a radio relocation flight at a location 15 air line km to the north of the South Fork of Dupuyer Creek. Bear 220 remained in the canyon and was active until about 9:45 a.m. Meanwhile seismic activity had begun by 8:10 a.m. Most early morning seismic activity was focused east of us on the east end of line 5. By 11:20 a.m. helicopters began slinging cable up into the South Fork of Dupuyer Canyon. At 1:33 p.m. crews began blasting on the east end of line 5. By 2:05 p.m., four large helicopters with sling loads had moved in and out of the canyon. Crews were busy stringing cable. Blasting had reached to within four km of bear 220 before we noticed significant activity responses by the bear. Each of the helicopter trips had also caused an activity response. By 2:15 p.m. bear 220 became fully active. Normal activity had not begun on August 24, 25, or 26 until after 3:00 p.m. Monitoring continued of bear 220 until 4:15 p.m. when the radio receiver lost power. Blasting continued as we left the canyon at 5:30 p.m. This morning we observed three black bears while in the evening period none were observed.

On August 28 contact was made with bear 220 at 7:00 a.m. The bear had remained in the South Fork of Dupuyer Canyon through the night. At 8:00 a.m. helicopters began coming back into the canyon. At 9:00 a.m. blasting began in the canyon mouth about .8 km from bear 220. By 9:25 a.m. blasts are extremely loud in the canyon and bear 220 has remained active. From 8:00 a.m. until 9:30 a.m. bear 220 remained stationary but active in a heavy timber patch near where she had bedded on August 26. By 9:30 a.m. bear 220 began to move west, up the canyon, away from the seismic blasts. Seismic blasting had approached to within .65 km of bear 220 when she began to move. At that distance seismic blasts caused severe reaction in horses used by the observer. Bear 220 moved slowly using all available cover until by 1:00 p.m. radio contact was lost. By 2:30 p.m. the seismic blasting was completed. Helicopter assisted crews were clearing the area. During the day and for a one hour observation period two black bears were observed in the canyon. An evening radio relocation flight revealed that grizzly 220 had moved 3 km up into the head of Dupuyer Creek canyon. On August 29 at 6:00 a.m. 220 was still located at the head of Dupuyer Creek near her location the evening of August 28.

On August 31 a ground crew went into Dupuyer Creek. Bear 220 was still up high in Dupuyer Creek on the evening of August 31. On the morning of September 1 at 9:10 a.m. bear 220 was located 6 km west of her August 31 location.

During an evening and morning observation period only one black bear was seen in the South Fork of Dupuyer on August 31 and September 1 a full three days since the seismic exploration took place.

In summary bear 335 left the South Fork of Dupuyer Creek the night following the beginning of a seismic survey in the canyon. Bear 220 left the canyon during midday when blasting began in the canyon within .65 km of her location. Bear 220 moved 3 km from her location whereas bear 335 had moved 15 km's north of her location before the exploration took place. At least three grizzlies and six black bears were present in the canyon before exploration. After the exploration process which came half way up the drainage only one grizzly and two black bears were present in the canyon. All were in the upper end of the canyon in the Great Bear wilderness area. Neither grizzlies or black bears moved back into the area near the seismic project for three full days after completion of the line. Both grizzly bears responded to helicopter activity within .8 km of their location. Neither bear in good cover would flee from helicopter activity but were awakened from inactive status. Bear 220 increased the length of her active period and consequently bedded for a shorter period when exploration was began near the South Fork Dupuyer than before exploration began.

Preliminary evidence suggests that: bears are displaced from key feeding areas by seismic exploration. Bears activity patterns are affected by activities near their location. Individual bears vary in their tolerance to seismic associated activity. This variation could be dependent on levels of habituation and experience by individual bears.

Proper distribution of seismic activity will create disturbance free zones where bears can move when displaced. (These zones should be no less than 6 km. from the nearest seismic activity. Nine mile spacing of lines provides for a mid point of about 7 km. from lines). Bears do react to aircraft passes but in good cover seldom flee.

Case 4

Bear 544, a 4.5 year old subadult male, was previously captured and monitored in the Teton River area. As a three-year old bear, he dispersed to the Badger - Two Medicine area where he had been establishing a new home range. On July 2 he moved into the Deep Creek area, only 1 km. from seismic Line 3, which was being shot from the north end. Bear 544 remained in the area until July 16. During that period, the sheep herd at Palookaville had suffered depredation losses. Also during that period, seismic crews blasted the north half of Line 3 and the remainder of Line 4. A helicopter LZ was located at Palookaville. Bear 544 was located five times by air and ground. On two occasions the helicopters were nearly over him in their flight path. He was located in secure timber and dense aspen cover at all locations. After the crews left the area, he was located once bedded within 50 m. of a completed seismic line. Analysis indicated that bear 544 remained in the area, but on the average was 3.22 km. from the blasting on the seismic operation of Lines 3 and 4. During that period and beyond, it appeared that bear 544 was attracted to the area of the sheep allotment and was trailing the band of sheep. The attraction of these sheep probably influenced the behavior of bear 544. After the sheep were removed from the allotment, bear 544 left the area. Later that year he was illegally killed and the carcass discovered.

In summary, bear 544 was not displaced from an area with a powerful attractant by seismic activity. Bear 544 was able to remain in the area, but selected secure bedding sites far enough away from the blasting but within striking distance of a band of sheep. The powerful influence of the attractant probably dampened the response of the bear to the seismic operations.

Case 5

Bear 366, a 5.5 year old female, was located on July 23 on the East side of the Continental Divide in Benson Creek. From July 23 to August 1 seismic operations were conducted on Line 5 from east to west moving toward the location of bear 366. On July 25 ground crews located bear 366. As seismic blasting came nearer to bear 366, she began moving west up the Sydney Creek drainage. Seismic blasting could be heard on the N. Fork of Badger and North on Line 11 coming down Benson Creek. Helicopters passed over the Divide repeatedly to the North and around Badger Cabin. At 2:30 p.m., bear 366 was moving west toward the Continental Divide. By 8:00 p.m. she had moved over the divide and settled in the head of Morrison Creek. She remained here until August 1 when the blasting on Line 11 crossed into Puzzle Creek to her north and west of the Continental Divide. Meanwhile, blasting on Line 5 was completed and by August 2 bear 366 had moved back into Sydney Creek. Bear 366 traveled 2.7 km. from July 25 to July 26 and 3.4 km. from July 27 to August 2 when she returned to Sydney Creek. During these monitoring periods she was very active during the daylight period.

In summary, bear 366 was exposed to slightly staggered seismic lines on each side (North and South) of her. She was able to use the Continental Divide as a topographic screen from the seismic activities of two lines that were 10.5 km. apart which had staggered shooting schedules. The bear moved 2.7 and 3.4 km. back and forth across the Divide to avoid these activities.

Case 6

Bear 366 had been located up and down a two mile stretch of Lee Creek six times between August 6 and August 20. She was active very much during daylight hours feeding on Sheperdia canadensis, common along this drainage. Movement between locations was generally one mile or less. From August 13 to August 17 seismic activities occurred on Line 12 about 4.8 km. north on Lost Shirt Creek, on the west portion of Line 15 about 4.8 km. south of bear 366, and on the west end of Line 19 about 5.6 km. to the south-east. No seismic activity was conducted in Lee Creek Drainage during that period. Seismic crews were within 10-13 km. of each other during much of that period from August 13 to August 17. Bear 366 appeared to remain in Lee Creek during this period with little behavioral response noted to activities going on in drainages 4.8 km. north and south of her berry fields.

In summary, bear 366 was not displaced a second time (refer to case 5) when exposed to seismic operations greater than three miles from her location. Factors influencing behavior during this period may be previous experience to the seismic activities, presence of ripening berries in a choice berry field, and adequate topographic screening of the activities from the bear.

Case 7

Bear 366 was located four times from ground and air from August 23 to August 30 in Lee Creek. She moved, as had been observed previously, up and down the creek, feeding on Shepherdia canadensis. During that period, the north half of Line 25 was shot, high across the upper end of Lee Creek. Bear 366 was monitored from 7:45 a.m. to 1:00 p.m. on August 30. Early that morning before seismic activity occurred, bear 366 had been on the upper end of Lee Creek. By 11:00 p.m. she had moved 2.4 km. down stream as blasting was conducted across the upper end of Lee Creek. Blasting was also occurring on Line 19 about 12.1 km. from the crew on Line 25. Bear 366 remained 4.0 km. from blasting activity on Seismic Line 25.

In summary, a seismic line across the upper edge or ridge line of a drainage did not cause bear 366 to leave a choice berry field. However, the bear did move to the lower edge of the drainage about 4.0 km. from the line. This is the third case report of bear 366's encounter with seismic activity and habituation to such activities may be a factor in this observed interaction.

Case 8

Bear 366 was located in Sydney Creek on September 4 as a seismic crew moved north on Line 21. This conflicts with U.S. Forest Service data that this line was shot from September 29 to October 10. Helicopters slinging gear, ground crews, and seismic blast were moving through lower Sydney Creek on September 4 to within 1 km. of bear 366. By September 5, with ground crews to monitor bear 366, she had moved 2.4 km. to the Lee Creek drainage. She was monitored in Lee Creek until 5:00 p.m. on September 6. Bear 366 behaved as expected during that period as seismic crews had moved north over 6.4 km. away.

In summary, bear 366 endured blasting at a distance of 0.8 km. away but soon afterwards left to the security of another favored drainage as seismic activity in Sydney Creek peaked.

Case 9

Grizzly bear 366, a female 6.5 years of age, was monitored from ground and air from August 26 until August 28 during which time a seismic operation was being conducted to the east of her location about 3 km. Bear 313 had previously been located next to the line before survey crews (helicopter assisted) began surveying on August 23 p.m. She was located on August 26 at 8:00 a.m., before seismic activity began. Initial monitoring began on August 26 at 9:30 p.m., while initial helicopter assisted seismic operations began the afternoon of that same day. By the time ground monitoring began, bear 366 had moved further up the N. Fork of Badger. She showed no signs of being disturbed by helicopter activity on August 27 which was over 5 km away from her location. Initial blasting on August 27 more than 4 km resulted in changes in activity as determined from the motion sensitive collar. From 11:00 a.m. until 2:20 p.m. on August 27, bear 366 appeared to be sensitive to the sound of blasting on the seismic line over 4 km distance from 2:20 until 2:30 p.m. She moved further up Pool Creek a distance of about of about 1 km. Seismic activity decreased in intensity at about 3:00 p.m. as the blasting and helicopters moved north along the seismic line. Seismic blasts from 3:00 p.m. to 5:00 p.m. were not particularly loud to the observer and registered no reaction by the bear, as reported by the observer. There were two ridges and drainages separating the bear from seismic activity. The bear was monitored until 7:30 p.m. on August 28 and located from the air once at 9:00 a.m. Seismic activity was by now over 6 km distance from the bear and showed no influence on activity or movements. Bear 366 remained in the head of Pool Creek until August 30.

In summary, helicopter activity occurring over 4 km from bear 366 seemed to cause little response by bear 366. However, blasting along the seismic line about 4 km distance appeared to disrupt normal activity and eventually bear 366 moved away from the activity putting ridges and drainage patterns between herself and the activity.

Further study on a case by case basis is needed to refine our understanding of grizzly bear response to seismic activity. Individual variation, habituation, presence of attractant, intensity of activity, and habitat preference/security can interact to create complicated scenarios which may be difficult to interpret. General rules providing seasonal restrictions, proper spacing and scheduling of seismograph programs seem most appropriate at this time. Recent results seem to indicate that guidelines in place for seismograph activity are adequate and are successfully working when adhered to.

Appendix F. Vegetation plot summary by habitat component
(9=Rock, 12=Prairie Grassland, 13=Mountain Grassland,
5=Sidehill Park, 3=Meadow, 8=Shrubfield, 6=Snowchute).

SPECIES	9 %F	9 CC	12 %F	12 CC	13 %F	13 CC	5 %F	5 CC	3 %F	3 CC	8 %F	8 CC	6 %F	6 CC
Abies lasiocarpa (>10 cm dbh)	11.1	0.1	0.0	0.0	0.0	0.0	10.0	0.1	20.0	3.0	75.0	2.9	50.0	0.3
Abies lasiocarpa (<10 cm dbh)	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.5	25.0	0.4	0.0	0.0
Juniperus scopulorum (>10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Picea engelmannii (>10 cm dbh)	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.6	50.0	0.3
Picea engelmannii (<10 cm dbh)	7.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.1	0.0	0.0
Pinus albicaulis (>10 cm dbh)	14.8	0.6	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	25.0	0.4	50.0	1.3
Pinus albicaulis (<10 cm dbh)	14.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	12.5	0.1	0.0	0.0
Pinus contorta (>10 cm dbh)	3.7	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	50.0	0.5	0.0	0.0
Pinus contorta (<10 cm dbh)	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.5	0.2	0.0	0.0
Pinus flexilis (>10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Pinus flexilis (<10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Populus angustifolia (>10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Populus tremuloides (>10 cm dbh)	3.7	0.1	0.0	0.0	0.0	0.0	10.0	1.5	40.0	0.6	0.0	0.0	0.0	0.0
Populus tremuloides (<10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	3.0	0.0	0.0	0.0	0.0
Populus trichocarpa (>10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Populus trichocarpa (<10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pseudotsuga menziesii (>10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	30.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Pseudotsuga menziesii (<10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	20.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0
Total Trees (>10 cm dbh)	29.6	0.9	0.0	0.0	0.0	0.0	70.0	2.2	60.0	3.6	75.0	8.1	100.0	1.5
Total trees (<10 cm dbh)	22.2	0.9	0.0	0.0	0.0	0.0	20.0	1.8	40.0	3.5	37.5	0.7	0.0	0.0
Acer glabrum	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Alnus sinuata	3.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	8.1	0.0	0.0
Betula occidentalis/occidentalis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Betula spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	1.9	0.0	0.0
Cornus stolonifera/stolonifera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Elaeagnus commutata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Salix spp.	7.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	50.0	0.3
Sorbus sitchensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.3	0.0	0.0
Sorbus scopulina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Tall Shrubs	7.4	1.5	0.0	0.0	0.0	0.0	10.0	0.1	20.0	0.1	37.5	10.0	50.0	0.3
Amelanchier alnifolia/alnifolia	3.7	0.0	0.0	0.0	0.0	0.0	70.0	5.7	0.0	0.0	25.0	1.9	0.0	0.0
Artemesia tridentata ssp. vaseyana	0.0	0.0	33.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ceanothus spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cercocarpus ledifolus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crataegus douglasii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Juniperus communis/montana	0.0	0.0	0.0	0.0	0.0	0.0	40.0	2.2	0.0	0.0	37.5	0.7	0.0	0.0
Lonicera involucrata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lonicera utahensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Menziesia ferrigina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.4	0.0	0.0
Potentilla fruticosa	29.6	0.5	100.0	6.0	50.0	7.5	60.0	4.8	80.0	0.8	50.0	2.3	0.0	0.0
Prunus virginiana/melanocarpa	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ribes americanam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ribes cereum/inebrians	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0
Ribes inerme	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ribes lacustre	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	50.0	7.5
Ribes montigenum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0
Ribes setosum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(9=Rock, 12=Prairie Grassland, 13=Mountain Grassland,
5=Sidehill Park, 3=Meadow, 8=Shrubfield, 6=Snowchute).

SPECIES	9	9	12	12	13	13	5	5	3	3	8	8	6	6
	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC
Ribes viscosissimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.3
Ribes ssp.	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	50.0	0.8	0.0	0.0
Rosa acicularis	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rosa arkansana	0.0	0.0	66.7	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rosa woodsii/ultramontana	7.4	0.0	0.0	0.0	0.0	0.0	30.0	0.6	60.0	0.7	0.0	0.0	0.0	0.0
Rosa spp.	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.3	20.0	0.1	12.5	0.1	0.0	0.0
Rubus idaeus/peramoenus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Rubus parviflorus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.4	0.0	0.0
Sambucus cerulea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sambucus racemosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	25.0	0.4	50.0	0.3
Shepherdia canadensis	7.4	0.2	0.0	0.0	0.0	0.0	30.0	0.6	20.0	0.1	62.5	29.7	0.0	0.0
Spirea betulifolia/lucida	3.7	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	25.0	0.4	0.0	0.0
Spirea densiflora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spirea spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.3	0.0	0.0
Symphoricarpos albus/albus	7.4	0.2	0.0	0.0	0.0	0.0	20.0	0.1	40.0	3.1	12.5	0.3	0.0	0.0
Symphoricarpos occidentalis	3.7	0.0	0.0	0.0	0.0	0.0	10.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Symphoricarpos oreophilus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vaccinium globulare	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	12.5	0.0	0.0
Total Medium Shrubs	44.4	1.7	100.0	10.2	50.0	7.5	100.0	13.5	80.0	4.5	100.0	49.7	50.0	7.5
Arctostaphylos uva-ursi	7.4	0.0	0.0	0.0	0.0	0.0	20.0	5.2	0.0	0.0	25.0	0.4	0.0	0.0
Artemesia campestris ssp borealis/	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Artemisia frigida	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Artemesia ludoviciana/ludoviciana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Artemesia ludoviciana/latiloba	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Artemesia spp.	11.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.3	0.0	0.0
Berberis repens	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	37.5	0.4	0.0	0.0
Chimaphila umbellata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clematis columbiana/columbiana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clematis pseudoalpina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clematis tenuiloba	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Dryas octopetala/hookeriana	3.7	0.1	33.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Juniperus horizontalis	3.7	0.0	33.3	0.8	0.0	0.0	20.0	0.3	20.0	0.1	12.5	0.1	0.0	0.0
Linnea borealis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ledum glandulosum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phyllodace empetriformis	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vaccinium myrtillus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.4	0.0	0.0
Vaccinium caespitosum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vaccinium scoparium	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	37.5	5.3	50.0	0.3
Total Low shrubs and Vines	25.9	0.2	66.7	1.0	0.0	0.0	60.0	5.7	20.0	0.1	87.5	7.9	50.0	0.3
Equisetum arvense	3.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	18.8
Equisetum spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mushroom spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thelypteris phegoptesis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Ferns and Fern Allies	3.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	18.8
Agropyron caninum spp. majus/majus	11.1	0.2	0.0	0.0	50.0	18.8	10.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Agropyron caninum spp. majus/andinum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	1.9	0.0	0.0
Agropyron Caninum ssp. majus/latiglume	7.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(9=Rock, 12=Prairie Grassland, 13=Mountain Grassland,
5=Sidehill Park, 3=Meadow, 8=Shrubfield, 6=Snowchute).

SPECIES	9 %F	9 CC	12 %F	12 CC	13 %F	13 CC	5 %F	5 CC	3 %F	3 CC	8 %F	8 CC	6 %F	6 CC
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Agropyron dasytachyum	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agropyron intermedium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agropyron repens	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.5	0.0	0.0	0.0	0.0
Agropyron scribneri	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agropyron smithii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agropyron spicatum/spicatum	14.8	0.2	33.3	0.8	50.0	0.3	50.0	2.1	40.0	0.2	0.0	0.0	50.0	0.3
Agropyron spp.	11.1	0.1	0.0	0.0	0.0	0.0	20.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0
Agrostis alba/alba	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agrostis spp.	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromus carinatus/carinatus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.5	0.0	0.0	0.0	0.0
Bromus inermis spp. inermis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromus tectorum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	7.5	0.0	0.0	0.0	0.0
Bromus spp.	3.7	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Calamagrostis canadensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0
Calamagrostis rubescens	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	12.5	0.1	0.0	0.0
Carex capillaris	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Carex concinnoides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Carex filifolia	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Carex geyeri	3.7	0.0	0.0	0.0	0.0	0.0	20.0	0.3	0.0	0.0	12.5	0.1	0.0	0.0
Carex spp.	18.5	0.2	0.0	0.0	0.0	0.0	10.0	0.1	60.0	3.6	12.5	0.1	0.0	0.0
Dactylis glomerata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Danthonia intermedia	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Danthonia spp.	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Deschampsia cespitosa/cespitosa	0.0	0.0	66.7	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deschampsia elongata	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Elymus glaucus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eriophorum scheuchzeri	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festuca idahoensis/idahoensis	33.3	1.0	66.7	5.8	50.0	18.8	80.0	4.5	40.0	0.6	25.0	2.2	50.0	7.5
Festuca ovina	14.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festuca scabrella	3.7	0.0	66.7	5.8	50.0	7.5	10.0	0.2	0.0	0.0	12.5	0.3	0.0	0.0
Glyceria grandis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Glyceria striata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.3	0.0	0.0
Juncus spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Koeleria cristata	0.0	0.0	66.7	1.7	0.0	0.0	10.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Luzula hitchcockii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Muhlenbergia cuspidata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Muhlenbergia spp.	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phalaris arundinacea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phleum alpinum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.5	0.0	0.0	0.0	0.0
Phleum pratense	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	7.6	12.5	0.3	0.0	0.0
Poa alpina	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poa fendleriana	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poa nervosa/wheeleri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0
Poa pratensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poa rupicola	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poa sandbergii	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poa scabrella	3.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(9=Rock, 12=Prairie Grassland, 13=Mountain Grassland,
5=Sidehill Park, 3=Meadow, 8=Shrubfield, 6=Snowchute).

SPECIES	9	9	12	12	13	13	5	5	3	3	8	8	6	6
	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC
Poa spp.	22.2	0.1	33.3	5.0	0.0	0.0	20.0	1.8	60.0	13.5	0.0	0.0	100.0	2.5
Scirpus americanus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scirpus spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sitanion hystrix	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stipa richardsonii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stipa viridula	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trisetum spicatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Typha latifolia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown cyperaceos	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Unknown graminae	37.0	0.3	33.3	28.3	50.0	0.3	60.0	5.8	20.0	12.5	62.5	8.6	0.0	0.0
Unknown juncaceae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Graminoids	92.6	5.0	100.0	54.2	100.0	38.8	100.0	20.5	100.0	52.5	100.0	15.7	100.0	8.8
Achillea millefolium ssp. lanulosa/	66.7	0.6	100.0	1.2	100.0	1.5	100.0	2.4	100.0	3.8	87.5	1.2	100.0	7.8
Actea rubra	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Actea rubra/neglecta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agoseris glauca/dasycephala	11.1	0.1	0.0	0.0	50.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agoseris aurantiaca	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agoseris spp.	14.8	0.1	33.3	0.2	0.0	0.0	10.0	0.1	20.0	0.1	0.0	0.0	0.0	0.0
Allium cernuum	7.4	0.0	33.3	0.2	50.0	0.3	20.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Allium spp.	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Anaphalis margaritacea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Androsace lehmanniana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anemone multifida/multifida	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anemone nuttalliana	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Anemone parviflora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anemone piperi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anemone spp.	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.2	0.0	0.0	25.0	0.4	0.0	0.0
Angelica arguta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	50.0	0.3
Angelica spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Antennaria alpina	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Antennaria anaphaloides	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Antennaria arcuata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Antennaria microphylla	14.8	0.1	66.7	1.0	50.0	1.3	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Antennaria parvifolia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Antennaria racemosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Antennaria spp.	11.1	0.1	0.0	0.0	50.0	1.3	60.0	0.3	0.0	0.0	12.5	0.1	0.0	0.0
Apocynum medium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aquilegia flavescens	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	50.0	1.3
Arabis glabra	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arctium minus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arctium lappa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arenaria congesta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	1.3
Arenaria lateriflora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arenaria nuttallii	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arenaria obtusiloba	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arenaria rossii/apetala	7.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arenaria aculeata	7.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(9=Rock, 12=Prairie Grassland, 13=Mountain Grassland,
5=Sidehill Park, 3=Meadow, 8=Shrubfield, 6=Snowchute).

SPECIES	9	9	12	12	13	13	5	5	3	3	8	8	6	6
	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC
Arenaria spp.	25.9	0.2	33.3	0.2	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Arnica cordifolia/cordifolia	3.7	0.0	0.0	0.0	0.0	0.0	20.0	0.3	20.0	0.1	37.5	0.2	0.0	0.0
Arnica latifolia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arnica longifolia	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arnica parryi	11.1	0.1	0.0	0.0	0.0	0.0	30.0	0.1	0.0	0.0	0.0	0.0	50.0	1.3
Arnica spp.	0.0	0.0	33.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aster alpigenus	0.0	0.0	0.0	0.0	50.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aster conspicuus	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.3
Aster foliaceus/parryi	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Aster spp.	33.3	0.3	0.0	0.0	50.0	0.3	30.0	0.3	40.0	0.6	100.0	2.8	50.0	1.3
Astragalus crassicarpus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Astragalus miser	3.7	0.0	33.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Astragalus missouriensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Astragalus robbinsii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Astragalus spp.	51.9	1.8	0.0	0.0	50.0	7.5	30.0	0.3	40.0	0.2	12.5	0.1	50.0	1.3
Balsamorhiza sagittata	0.0	0.0	0.0	0.0	50.0	0.3	30.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Barbarea orthoceras	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Besseya wyomingensis	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bupleurum americanum	18.5	0.2	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Calochortus gunnisonii	3.7	0.0	0.0	0.0	50.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calypso bulbosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Campanula rotundifolia	14.8	0.1	0.0	0.0	0.0	0.0	30.0	0.1	0.0	0.0	12.5	0.1	0.0	0.0
Cardamine rupicola	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Castilleja miniata/miniata	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	12.5	0.3	0.0	0.0
Castilleja sulphurea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Castilleja spp.	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Cerastium arvense	25.9	0.1	66.7	0.3	100.0	0.5	30.0	0.1	40.0	0.2	0.0	0.0	0.0	0.0
Cerastium berringianum	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cerastium spp.	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chenopodium chenopodioides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chenopodium spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chrysopsis villosa/foliosa	11.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cicuta douglasii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.3
Cirsium arvense/horridum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	1.0	12.5	0.1	0.0	0.0
Cirsium scariosum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cirsium vulgare	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cirsium spp.	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	50.0	0.3
Clematis hirsutissima	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	12.5	0.1	0.0	0.0
Claytonia lanceolata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Claytonia megarhiza	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Collinsia parviflora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Comandra umbellata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Conringia orientalis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0
Corallorhiza striata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cruciferae spp.	3.7	0.0	0.0	0.0	0.0	0.0	20.0	0.1	20.0	7.5	0.0	0.0	0.0	0.0
Cryptantha interrupta	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cryptantha spp.	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(9=Rock, 12=Prairie Grassland, 13=Mountain Grassland,
5=Sidehill Park, 3=Meadow, 8=Shrubfield, 6=Snowchute).

SPECIES	9	9	12	12	13	13	5	5	3	3	8	8	6	6
	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC
Cynoglossum officinale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.2	0.0	0.0	0.0	0.0
Cypripedium calceolus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cypripedium montanum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Delphinium biocolor	3.7	0.0	66.7	0.3	0.0	0.0	20.0	0.1	20.0	0.1	0.0	0.0	0.0	0.0
Delphinium spp.	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disporum trachycarpum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dodecatheon conjugens	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	20.0	0.1	0.0	0.0	0.0	0.0
Dodecatheon pulchellum	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Douglasia montana	7.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Draba oligosperma/oligosperma	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Draba paysonii	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Draba spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.3
Epilobium angustifolium	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	20.0	0.1	50.0	2.3	50.0	0.3
Epilobium glandulosum	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Erigeron aureus	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Erigeron compositus/glabratus	18.5	0.6	100.0	1.2	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Erigeron speciosus/speciosus	3.7	0.0	0.0	0.0	50.0	0.3	10.0	0.1	20.0	0.1	12.5	0.1	0.0	0.0
Erigeron spp.	7.4	0.0	0.0	0.0	50.0	0.3	40.0	0.4	0.0	0.0	37.5	0.7	50.0	1.3
Eriogonum flavum/flavum	3.7	0.1	33.3	0.2	50.0	1.3	10.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Eriogonum heracleoides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Eriogonum ovalifolium/macropodum	11.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eriogonum umbellatum/subalpinum	3.7	0.1	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Eriogonum spp.	14.8	0.1	0.0	0.0	0.0	0.0	40.0	0.4	0.0	0.0	12.5	0.3	0.0	0.0
Eriophyllum lanatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.6	0.0	0.0	0.0	0.0
Eritrichium howardii	0.0	0.0	33.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Erysimum asperum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Erythronium grandiflorum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euphorbia esula	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fragaria virginiana/glauca	11.1	0.1	0.0	0.0	50.0	1.3	40.0	1.6	40.0	0.6	62.5	2.6	50.0	0.3
Frasera speciosa	22.2	0.2	0.0	0.0	0.0	0.0	10.0	0.1	20.0	0.1	0.0	0.0	0.0	0.0
Fritillaria pudica	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Gaillardia aristata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Galium boreale	22.2	0.1	33.3	0.2	50.0	0.3	50.0	0.5	40.0	0.2	62.5	0.3	0.0	0.0
Galium triflorum	3.7	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Gentiana affinis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gentiana amarella	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.3
Gentiana calycosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0
Gentiana spp.	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Geranium richardsonii	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	12.5	0.1	0.0	0.0
Geranium viscosissimum/	0.0	0.0	33.3	0.2	0.0	0.0	30.0	0.1	20.0	0.1	12.5	0.1	0.0	0.0
Geranium spp.	0.0	0.0	0.0	0.0	50.0	0.3	0.0	0.0	0.0	0.0	12.5	0.3	0.0	0.0
Geum aleppicum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.3	0.0	0.0
Geum macrophyllum/macrophyllum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0
Geum triflorum/triflorum	7.4	0.0	0.0	0.0	0.0	0.0	20.0	0.1	40.0	0.2	0.0	0.0	0.0	0.0
Glycyrrhiza lepidota/lepidota	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Guttierrezia sarothrae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Habenaria dilatata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(9=Rock, 12=Prairie Grassland, 13=Mountain Grassland,
5=Sidehill Park, 3=Meadow, 8=Shrubfield, 6=Snowchute).

SPECIES	9	9	12	12	13	13	5	5	3	3	8	8	6	6
------------------------------	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC
	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Habenaria spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Habenaria viridis	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hackelia floribunda	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hedysarum alpinum	33.3	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hedysarum boreale/cinerascens	0.0	0.0	0.0	0.0	0.0	0.0	10.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Hedysarum spp.	0.0	0.0	33.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Hedysarum sulphurescens	11.1	0.1	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Helianthella uniflora	7.4	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Helianthus annuus	3.7	0.0	0.0	0.0	50.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Helianthus nuttallii/nutallii	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Helianthus spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heracleum lanatum	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	7.5	37.5	4.8	50.0	1.3
Heuchera cylindrica/glabella	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	50.0	0.3
Heuchera parvifolia/dissecta	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Heuchera spp.	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hieracium gracile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hieracium spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydrophyllum capitatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hymenoxys acaulis/acaulis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Iris missouriensis	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	20.0	0.1	0.0	0.0	0.0	0.0
Ivesia gordonii	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lactuca pulchella	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lathyrus ochroleucus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lathyrus spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leguminosae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lesquerella alpina	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ligusticum spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ligusticum verticillatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Linum perenne/lewisii	11.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lithospermum ruderale	0.0	0.0	0.0	0.0	0.0	0.0	30.0	0.1	20.0	0.1	0.0	0.0	0.0	0.0
Lomatium cous	44.4	0.4	66.7	5.8	50.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lomatium dissectum/multifidum	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Lomatium geyeri	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Lomatium macrocarpum	7.4	0.1	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Lomatium spp.	18.5	0.2	0.0	0.0	50.0	0.3	20.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Lupinus sericeus/sericeus	29.6	1.3	66.7	0.3	50.0	7.5	50.0	0.7	20.0	0.1	25.0	0.1	0.0	0.0
Madia spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medicago lupulina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medicago sativa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Melilotus alba	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Melilotus officinalis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mentha arvensis/glabrata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Menyanthes trifoliata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mertensia ciliata/ciliata	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mertensia longiflora	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Mitella breweri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Monarada fistulosa/menthifolia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(9=Rock, 12=Prairie Grassland, 13=Mountain Grassland,
5=Sidehill Park, 3=Meadow, 8=Shrubfield, 6=Snowchute).

SPECIES	9 %F	9 CC	12 %F	12 CC	13 %F	13 CC	5 %F	5 CC	3 %F	3 CC	8 %F	8 CC	6 %F	6 CC
Myosotis arvensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Orthocarpus tenuifolius	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Osmorhiza chilensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Osmorhiza occidentalis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Osmorhiza spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oxytropis bessayi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oxytropis sericea/spicata	0.0	0.0	33.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oxytropis splendens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oxytropis viscida	0.0	0.0	33.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oxytropis spp.	14.8	0.1	66.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Parnassia fimbriata/fimbriata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Parnassia palustris	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pastinaca sativa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedicularis bracteosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedicularis contorta/contorta	3.7	0.1	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Pedicularis groenlandica	22.2	0.1	0.0	0.0	0.0	0.0	20.0	0.1	20.0	0.1	25.0	0.1	0.0	0.0
Pedicularis racemosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	1.3
Pedicularis spp.	3.7	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	12.5	0.3	0.0	0.0
Penstemon confertus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Penstemon davidsonii/menziesia	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Penstemon eriantherus/eriantherus	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	20.0	0.1	0.0	0.0	0.0	0.0
Penstemon nitidus/nitidus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Penstemon procerus/procerus	0.0	0.0	0.0	0.0	50.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Penstemon spp.	7.4	0.0	0.0	0.0	0.0	0.0	10.0	1.5	0.0	0.0	25.0	0.6	0.0	0.0
Phacelia sericea	11.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	1.5
Phacelia lyalli	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phlox hoodii	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phlox spp.	7.4	0.6	33.3	0.2	0.0	0.0	10.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Physaria didymocarpa	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plantago eriopoda	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polemonium occidentale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polemonium pulcherrimum	18.5	0.2	33.3	0.2	0.0	0.0	10.0	0.2	20.0	0.1	12.5	0.1	0.0	0.0
Polygonum bistortoides	0.0	0.0	33.3	0.2	50.0	0.3	20.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Potentilla glandulosa	7.4	0.0	0.0	0.0	0.0	0.0	20.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Potentilla gracilis/glabrata	0.0	0.0	33.3	0.2	0.0	0.0	10.0	0.1	100.0	0.9	0.0	0.0	100.0	1.5
Potentilla gracilis/flabelliformis	0.0	0.0	0.0	0.0	0.0	0.0	30.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Potentilla ovina	7.4	0.0	66.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Potentilla spp.	22.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.3	0.0	0.0
Primula incana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrola chlorantha	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrola minor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrola secunda	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrola uniflora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrola spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ranunculus glabberimus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ranunculus spp.	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	18.8
Rumex crispus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(9=Rock, 12=Prairie Grassland, 13=Mountain Grassland,
5=Sidehill Park, 3=Meadow, 8=Shrubfield, 6=Snowchute).

SPECIES	9	9	12	12	13	13	5	5	3	3	8	8	6	6
	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC
Sanicula marilandica	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saxifraga bronchialis/austromontana	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saxifraga oppositifolia	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saxifraga rhomboidea	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Sedum lanceolatum/lanceolatum	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	1.3
Sedum stenopetalum	18.5	0.1	0.0	0.0	50.0	7.5	50.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Sedum spp.	14.8	0.6	66.7	1.0	0.0	0.0	20.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Senecio canus	11.1	0.1	66.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Senecio fremontii	3.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Senecio indecorus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Senecio pauperculus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Senecio spp.	37.0	0.2	0.0	0.0	50.0	0.3	10.0	0.1	0.0	0.0	12.5	0.1	50.0	0.3
Senecio triangularis/trianyularis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	3.0	25.0	0.1	50.0	1.3
Sibbaldia procumbens	3.7	0.0	33.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Silene acaulis	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smilacina racemosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smilacina stellata	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Solidago canadensis/salebrosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidago missouriensis/	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidago multiradiata	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Solidago spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.3	0.0	0.0
Spiranthes romanzoffiana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stachys palustris/pilosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Streptopus amplexifolius/chalazatus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Taraxacum officinale	14.8	0.1	33.3	0.2	0.0	0.0	20.0	0.3	40.0	0.6	12.5	0.1	50.0	0.3
Taraxacum spp.	0.0	0.0	0.0	0.0	50.0	0.3	30.0	0.3	0.0	0.0	25.0	0.1	0.0	0.0
Thalictrum occidentale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.6	50.0	0.5	0.0	0.0
Townsendia parryi	11.1	0.1	33.3	0.2	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Tragopogon dubius	0.0	0.0	33.3	0.2	0.0	0.0	10.0	0.1	20.0	0.1	0.0	0.0	0.0	0.0
Trifolium longipes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trifolium pratense	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trifolium repens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trifolium spp.	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	60.0	0.3	0.0	0.0	0.0	0.0
Urtica dioica ssp. gracilis/gracilis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Urtica dioica ssp. gracilis/procera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0
Unknown forb	37.0	0.4	33.3	0.2	50.0	0.3	40.0	0.2	40.0	0.2	87.5	2.8	0.0	0.0
Valeriana dioica	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Valeriana occidentalis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	18.8
Valeriana sitchensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0
Valeriana spp.	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Veratrum viride	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	2.2	0.0	0.0
Vicia americana/truncata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vicia sativa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.1	0.0	0.0
Vicia spp.	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	20.0	0.1	12.5	0.1	0.0	0.0
Viola adunca	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Viola canadensis/rugulosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Viola glabella	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(9=Rock, 12=Prairie Grassland, 13=Mountain Grassland,
5=Sidehill Park, 3=Meadow, 8=Shrubfield, 6=Snowchute).

SPECIES	9	9	12	12	13	13	5	5	3	3	8	8	6	6
	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC
Viola orbiculata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Viola spp.	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	12.5	0.1	50.0	0.3
Xerophyllum tenax	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.5	18.2	50.0	0.3
Zigadenus elegans	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.1	0.0	0.0	0.0	0.0
Zigadenus venenosus/gramineus	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Total forbs	100.0	15.9	100.0	22.5	100.0	38.8	100.0	24.2	100.0	31.5	100.0	37.8	100.0	50.0
Moss	18.5	0.7	0.0	0.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Mineral Soil	100.0	34.6	66.7	12.7	100.0	19.0	100.0	15.1	100.0	0.9	75.0	2.9	50.0	7.5
Rock	96.3	37.2	66.7	12.7	0.0	0.0	90.0	4.2	60.0	0.5	62.5	3.9	100.0	8.8

Appendix F. Vegetation plot summary by habitat component (10=Closed Timber, 17=Open Timber, 18=Timbered Shrubfield, 11=Limber Pine Savanna, 16=Riparian Complex, 14=Populus Stand, 15=Riparian Shrub).

SPECIES	10 %F	10 CC	17 %F	17 CC	18 %F	18 CC	11 %F	11 CC	16 %F	16 CC	14 %F	14 CC	15 %F	15 CC
Abies lasiocarpa (>10 cm dbh)	58.5	9.9	52.9	5.2	66.7	2.8	9.1	0.0	33.3	2.6	3.3	0.0	0.0	0.0
Abies lasiocarpa (<10 cm dbh)	58.5	10.2	41.2	3.3	55.6	9.1	9.1	0.0	33.3	2.6	3.3	0.1	0.0	0.0
Juniperus scopulorum (>10 cm dbh)	3.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Picea engelmannii (>10 cm dbh)	40.0	1.3	39.2	1.2	38.9	1.2	0.0	0.0	50.0	2.7	13.3	0.4	2.0	0.0
Picea engelmannii (<10 cm dbh)	46.2	5.6	41.2	1.6	38.9	1.4	0.0	0.0	50.0	0.9	8.3	0.1	2.0	0.0
Pinus albicaulis (>10 cm dbh)	18.5	1.3	21.6	0.8	11.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pinus albicaulis (<10 cm dbh)	38.5	6.2	33.3	2.7	11.1	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pinus contorta (>10 cm dbh)	26.2	1.6	17.6	0.5	83.3	4.9	0.0	0.0	0.0	0.0	3.3	0.1	0.0	0.0
Pinus contorta (<10 cm dbh)	38.5	7.4	19.6	1.5	83.3	19.9	0.0	0.0	33.3	2.9	3.3	0.3	0.0	0.0
Pinus flexilis (>10 cm dbh)	9.2	0.6	21.6	0.2	0.0	0.0	72.7	12.3	0.0	0.0	10.0	0.1	0.0	0.0
Pinus flexilis (<10 cm dbh)	12.3	1.6	19.6	1.5	0.0	0.0	90.9	7.4	0.0	0.0	6.7	0.3	0.0	0.0
Populus angustifolia (>10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Populus tremuloides (>10 cm dbh)	16.9	1.0	3.9	0.1	5.6	2.1	0.0	0.0	16.7	0.4	76.7	12.5	19.6	1.1
Populus tremuloides (<10 cm dbh)	12.3	1.9	3.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	80.0	15.5	13.7	0.1
Populus trichocarpa (>10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3	0.5	0.0	0.0
Populus trichocarpa (<10 cm dbh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	2.1	0.0	0.0
Pseudotsuga menziesii (>10 cm dbh)	29.2	2.7	45.1	1.6	16.7	2.1	45.5	1.9	16.7	0.4	15.0	0.1	0.0	0.0
Pseudotsuga menziesii (<10 cm dbh)	41.5	11.4	49.0	7.8	22.2	1.7	36.4	1.7	33.3	8.8	15.0	0.6	0.0	0.0
Total Trees (>10 cm dbh)	95.4	19.6	98.0	11.4	88.9	15.4	81.8	13.5	83.3	5.9	90.0	13.7	19.6	1.1
Total trees (<10 cm dbh)	96.9	44.2	94.1	19.4	88.9	32.9	100.0	10.8	83.3	17.6	91.7	19.3	13.7	0.1
Acer glabrum	9.2	0.4	11.8	0.1	5.6	0.0	0.0	0.0	0.0	0.0	6.7	0.9	0.0	0.0
Alnus sinuata	9.2	1.1	2.0	0.3	50.0	18.5	0.0	0.0	50.0	9.2	0.0	0.0	0.0	0.0
Betula occidentalis/occidentalis	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	2.8	41.2	6.6
Betula spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	1.1	7.8	1.1
Cornus stolonifera/stolonifera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.3	4.5	54.9	3.4
Elaeagnus commutata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	0.6	11.8	0.7
Salix spp.	7.7	0.3	3.9	0.1	11.1	0.3	0.0	0.0	83.3	5.6	73.3	13.4	100.0	45.3
Sorbus sitchensis	6.2	0.1	2.0	0.0	16.7	0.2	0.0	0.0	16.7	0.4	1.7	0.2	0.0	0.0
Sorbus scopulina	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Tall Shrubs	29.2	2.1	15.7	0.4	66.7	18.8	0.0	0.0	100.0	18.0	81.7	23.1	100.0	55.1
Amelanchier alnifolia/alnifolia	6.2	0.1	9.8	0.4	11.1	0.9	0.0	0.0	16.7	0.1	21.7	5.1	11.8	1.9
Artemesia tridentata ssp. vaseyana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ceanothus spp.	1.5	0.2	2.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cercocarpus ledifolus	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crataegus douglasii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.2	0.0	0.0
Juniperus communis/montana	21.5	1.7	27.5	1.3	27.8	1.1	36.4	0.9	33.3	0.5	6.7	0.1	0.0	0.0
Lonicera involucrata	3.1	0.1	2.0	0.0	5.6	0.0	0.0	0.0	16.7	0.4	0.0	0.0	0.0	0.0
Lonicera utahensis	1.5	0.0	2.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Menziesia ferrigina	15.4	1.2	2.0	0.0	22.2	1.1	0.0	0.0	33.3	6.7	0.0	0.0	0.0	0.0
Potentilla fruticosa	16.9	0.6	27.5	0.6	16.7	0.9	100.0	5.2	16.7	0.1	30.0	0.8	27.5	0.6
Prunus virginiana/melanocarpa	1.5	0.0	0.0	0.0	0.0	0.0	18.2	1.6	0.0	0.0	26.7	2.5	15.7	1.9
Ribes americanam	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ribes cereum/inebrians	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ribes inerme	1.5	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Ribes lacustre	21.5	1.2	11.8	0.5	11.1	0.1	9.1	0.0	33.3	0.2	21.7	1.0	17.6	0.2
Ribes montigenum	9.2	0.1	3.9	0.1	5.6	0.0	0.0	0.0	16.7	0.1	6.7	0.3	13.7	0.1

Appendix F. Vegetation plot summary by habitat component (10=Closed Timber, 17=Open Timber, 18=Timbered Shrubfield, 11=Limber Pine Savanna, 16=Riparian Complex, 14=Populus Stand, 15=Riparian Shrub).

SPECIE	10 %F	10 CC	17 %F	17 CC	18 %F	18 CC	11 %F	11 CC	16 %F	16 CC	14 %F	14 CC	15 %F	15 CC
Ribes setosum	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Ribes viscosissimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Ribes ssp.	1.5	0.2	5.9	0.4	16.7	0.1	9.1	0.2	16.7	2.5	16.7	0.1	15.7	0.1
Rosa acicularis	1.5	0.0	7.8	0.4	0.0	0.0	9.1	0.0	0.0	0.0	6.7	0.4	11.8	0.4
Rosa arkansana	0.0	0.0	0.0	0.0	0.0	0.0	18.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Rosa woodsii/ultramontana	35.4	1.3	19.6	0.2	16.7	1.1	36.4	2.0	0.0	0.0	73.3	3.6	68.6	1.4
Rosa spp.	1.5	0.0	2.0	0.0	11.1	0.1	27.3	0.5	0.0	0.0	10.0	1.2	0.0	0.0
Rubus idaeus/peramoenus	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Rubus parviflorus	7.7	0.1	5.9	0.3	16.7	0.2	0.0	0.0	33.3	0.2	5.0	0.1	0.0	0.0
Sambucus cerulea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Sambucus racemosa	1.5	0.0	5.9	0.1	16.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Shepherdia canadensis	26.2	2.0	37.3	2.7	55.6	15.7	81.8	9.8	66.7	3.1	16.7	0.8	2.0	0.0
Spirea betulifolia/lucida	43.1	3.0	33.3	2.0	44.4	2.7	36.4	0.9	66.7	2.8	23.3	1.5	5.9	0.0
Spirea densiflora	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Spirea spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Symphoricarpos albus/albus	15.4	0.8	21.6	1.2	33.3	4.5	18.2	0.3	0.0	0.0	31.7	2.2	35.3	1.8
Symphoricarpos occidentalis	15.4	0.5	9.8	0.1	0.0	0.0	36.4	1.9	16.7	0.1	45.0	2.7	23.5	0.3
Symphoricarpos oreophilus	6.2	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Vaccinium globulare	6.2	0.5	9.8	0.5	16.7	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Medium Shrubs	89.2	14.0	84.3	13.4	100.0	37.3	100.0	22.0	100.0	20.4	96.7	18.0	96.1	7.8
Arctostaphylos uva-ursi	9.2	0.9	11.8	0.1	11.1	2.2	72.7	9.5	0.0	0.0	11.7	0.1	2.0	0.0
Artemesia campestris ssp borealis/	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Artemisia frigida	0.0	0.0	3.9	0.0	0.0	0.0	9.1	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Artemesia ludoviciana/ludoviciana	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Artemesia ludoviciana/latiloba	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Artemesia spp.	0.0	0.0	2.0	0.0	0.0	0.0	18.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Berberis repens	16.9	0.7	13.7	0.1	5.6	0.1	0.0	0.0	16.7	2.5	6.7	0.0	0.0	0.0
Chimaphila umbellata	1.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clematis columbiana/columbiana	0.0	0.0	11.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.3	2.0	0.0
Clematis pseudoalpina	18.5	0.6	13.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.1	2.0	0.0
Clematis tenuiloba	7.7	0.5	3.9	0.0	0.0	0.0	9.1	0.2	0.0	0.0	8.3	0.1	0.0	0.0
Dryas octopetala/hookeriana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Juniperus horizontalis	9.2	0.1	5.9	0.0	5.6	0.8	100.0	7.6	0.0	0.0	16.7	0.3	11.8	0.1
Linnea borealis	6.2	2.3	3.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Ledum glandulosum	1.5	0.0	0.0	0.0	5.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phyllodace empetriformis	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vaccinium myrtillus	6.2	0.3	7.8	0.4	5.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vaccinium caespitosum	4.6	0.3	0.0	0.0	22.2	3.8	0.0	0.0	33.3	0.5	1.7	0.2	0.0	0.0
Vaccinium scoparium	41.5	8.7	39.2	6.6	66.7	15.3	0.0	0.0	16.7	0.1	1.7	0.0	0.0	0.0
Total Low shrubs and Vines	81.5	14.9	80.4	8.4	83.3	25.4	100.0	14.4	66.7	3.1	38.3	1.2	15.7	0.1
Equisetum arvense	6.2	0.5	3.9	0.3	0.0	0.0	0.0	0.0	83.3	23.1	40.0	6.5	52.9	3.1
Equisetum spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	7.8	0.1
Mushroom spp.	1.5	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	2.0	0.0
Thelypteris phegoptesis	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Total Ferns and Fern Allies	10.8	0.5	7.8	0.4	0.0	0.0	0.0	0.0	83.3	23.1	45.0	6.6	62.7	3.3
Agropyron caninum spp. majus/majus	3.1	0.1	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.1	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(10=Closed Timber, 17=Open Timber, 18=Timbered Shrubfield,
11=Limber Pine Savanna, 16=Riparian Complex, 14=Populus
Stand, 15=Riparian Shrub).

SPECIE	10 %F	10 CC	17 %F	17 CC	18 %F	18 CC	11 %F	11 CC	16 %F	16 CC	14 %F	14 CC	15 %F	15 CC
Agropyron caninum spp. majus/andinum	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.1	0.0	0.0
Agropyron Caninum ssp. majus/latiglume	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agropyron dasytachyum	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agropyron intermedium	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3
Agropyron repens	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agropyron scribneri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agropyron smithii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.3
Agropyron spicatum/spicatum	1.5	0.0	7.8	0.6	5.6	0.8	72.7	5.6	0.0	0.0	1.7	0.0	0.0	0.0
Agropyron spp.	1.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	16.7	0.4	0.0	0.0	0.0	0.0
Agrostis alba/alba	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Agrostis spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromus carinatus/carinatus	6.2	0.2	2.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	10.0	0.2	2.0	0.0
Bromus inermis spp. inermis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	1.7
Bromus tectorum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromus spp.	1.5	0.0	2.0	0.0	5.6	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calamagrostis canadensis	9.2	0.6	5.9	0.8	0.0	0.0	0.0	0.0	0.0	0.0	21.7	1.7	7.8	0.4
Calamagrostis rubescens	33.8	3.3	17.6	1.3	22.2	2.4	9.1	0.2	16.7	0.1	10.0	0.6	2.0	0.0
Carex capillaris	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	2.5	0.0	0.0	0.0	0.0
Carex concinnoides	4.6	0.1	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Carex filifolia	0.0	0.0	0.0	0.0	0.0	0.0	18.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Carex geyeri	12.3	1.7	15.7	1.3	11.1	2.1	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Carex spp.	7.7	0.5	9.8	0.6	0.0	0.0	9.1	0.0	33.3	0.2	30.0	3.2	33.3	4.9
Dactylis glomerata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.3	0.0	0.0
Danthonia intermedia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Danthonia spp.	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Deschampsia cespitosa/cespitosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Deschampsia elongata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0
Elymus glaucus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.7
Eriophorum scheuchzeri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festuca idahoensis/idahoensis	1.5	0.0	21.6	2.4	11.1	0.2	45.5	6.2	16.7	0.4	0.0	0.0	0.0	0.0
Festuca ovina	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Festuca scabrella	1.5	0.0	7.8	0.1	0.0	0.0	81.8	7.1	0.0	0.0	3.3	0.0	0.0	0.0
Glyceria grandis	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Glyceria striata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Juncus spp.	0.0	0.0	0.0	0.0	5.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.7
Koeleria cristata	1.5	0.0	2.0	0.0	0.0	0.0	27.3	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Luzula hitchcockii	3.1	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Muhlenbergia cuspidata	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.2	0.0	0.0	1.7	0.0	0.0	0.0
Muhlenbergia spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phalaris arundinacea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Phleum alpinum	0.0	0.0	3.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phleum pratense	0.0	0.0	7.8	0.8	5.6	0.0	0.0	0.0	0.0	0.0	30.0	3.1	21.6	1.7
Poa alpina	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poa fendleriana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poa nervosa/wheeleri	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poa pratensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.6	9.8	1.9

Appendix F. Vegetation plot summary by habitat component (10=Closed Timber, 17=Open Timber, 18=Timbered Shrubfield, 11=Limber Pine Savanna, 16=Riparian Complex, 14=Populus Stand, 15=Riparian Shrub).

SPECIE	10	10	17	17	18	18	11	11	16	16	14	14	15	15
	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC
Poa rupicola	1.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poa sandbergii	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.2	0.0	0.0	0.0	0.0	2.0	0.0
Poa scabrella	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Poa spp.	12.3	1.1	9.8	0.2	11.1	0.2	0.0	0.0	50.0	0.6	36.7	4.6	43.1	2.3
Scirpus americanus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Scirpus spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.2	3.9	0.1
Sitanion hystrix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stipa richardsonii	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stipa viridula	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Trisetum spicatum	1.5	0.0	3.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Typha latifolia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0
Unknown cyperaceos	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.0	17.6	0.2
Unknown graminae	23.1	0.2	31.4	0.6	33.3	0.2	9.1	0.2	66.7	3.1	51.7	1.3	56.9	4.0
Unknown juncaceae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	0.8
Total Graminoids	75.4	8.2	84.3	8.8	72.2	7.0	100.0	26.4	100.0	8.4	98.3	16.0	98.0	21.6
Achillea millefolium ssp. lanulosa/	13.8	0.2	49.0	0.7	27.8	0.9	81.8	0.4	66.7	0.7	35.0	0.3	19.6	0.2
Actea rubra	3.1	0.2	2.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	20.0	0.4	11.8	0.1
Actea rubra/neglecta	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	9.8	0.0
Agoseris glauca/dasycephala	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agoseris aurantiaca	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agoseris spp.	1.5	0.0	2.0	0.0	11.1	0.1	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Allium cernuum	0.0	0.0	3.9	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.1
Allium spp.	1.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	5.9	0.0
Anaphalis margaritacea	0.0	0.0	3.9	0.1	5.6	0.0	9.1	0.0	16.7	0.1	0.0	0.0	0.0	0.0
Androsace lehmanniana	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anemone multifida/multifida	1.5	0.0	3.9	0.0	0.0	0.0	27.3	0.1	0.0	0.0	3.3	0.0	0.0	0.0
Anemone nuttalliana	1.5	0.0	7.8	0.1	0.0	0.0	18.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Anemone parviflora	1.5	0.0	0.0	0.0	0.0	0.0	18.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Anemone piperi	1.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Anemone spp.	0.0	0.0	7.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Angelica arguta	9.2	0.3	7.8	0.1	5.6	0.0	0.0	0.0	50.0	10.6	31.7	0.4	21.6	0.1
Angelica spp.	3.1	0.0	2.0	0.0	5.6	0.1	0.0	0.0	16.7	0.1	13.3	0.2	17.6	0.7
Antennaria alpina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Antennaria anaphaloides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Antennaria arcuata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Antennaria microphylla	3.1	0.0	2.0	0.0	0.0	0.0	36.4	0.5	0.0	0.0	5.0	0.1	0.0	0.0
Antennaria parvifolia	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Antennaria racemosa	4.6	0.0	3.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.1	0.0	0.0
Antennaria spp.	1.5	0.0	13.7	0.1	0.0	0.0	36.4	0.2	16.7	2.5	3.3	0.1	3.9	0.0
Apocynum medium	1.5	0.0	2.0	0.0	0.0	0.0	18.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Aquilegia flavescens	12.3	0.1	9.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.3	2.0	0.0
Arabis glabra	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	2.5	0.0	0.0	0.0	0.0
Arctium minus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.1	5.9	0.0
Arctium lappa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3
Arenaria congesta	1.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arenaria lateriflora	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(10=Closed Timber, 17=Open Timber, 18=Timbered Shrubfield,
11=Limber Pine Savanna, 16=Riparian Complex, 14=Populus
Stand, 15=Riparian Shrub).

SPECIE	10 %F	10 CC	17 %F	17 CC	18 %F	18 CC	11 %F	11 CC	16 %F	16 CC	14 %F	14 CC	15 %F	15 CC
Arenaria nuttallii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arenaria obtusiloba	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arenaria rossii/apetala	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arenaria aculeata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arenaria spp.	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0
Arnica cordifolia/cordifolia	58.5	3.6	52.9	1.0	72.2	5.8	0.0	0.0	66.7	5.2	26.7	0.8	3.9	0.0
Arnica latifolia	13.8	1.7	13.7	1.0	11.1	2.1	0.0	0.0	0.0	0.0	1.7	0.0	3.9	0.0
Arnica longifolia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arnica parryi	0.0	0.0	2.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arnica spp.	4.6	0.1	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aster alpigenus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aster conspicuus	33.8	1.5	23.5	1.0	5.6	0.1	9.1	0.2	16.7	0.1	3.3	0.1	5.9	0.0
Aster foliaceus/parryi	4.6	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	5.0	0.1	0.0	0.0
Aster spp.	16.9	0.8	33.3	1.0	50.0	1.2	18.2	0.1	66.7	0.7	8.3	0.1	13.7	0.1
Astragalus crassicarpus	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Astragalus miser	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Astragalus missouriensis	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Astragalus robbinsii	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.3	0.0	0.0
Astragalus spp.	7.7	0.1	15.7	1.1	11.1	0.1	27.3	0.1	0.0	0.0	1.7	0.0	2.0	0.0
Balsamorhiza sagittata	1.5	0.0	7.8	0.4	0.0	0.0	36.4	1.5	0.0	0.0	1.7	0.0	0.0	0.0
Barbarea orthoceras	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Besseya wyomingensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bupleurum americanum	7.7	0.1	3.9	0.0	5.6	0.8	63.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Calochortus gunnisonii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calypso bulbosa	1.5	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Campanula rotundifolia	6.2	0.0	11.8	0.1	16.7	0.1	27.3	0.1	16.7	0.1	6.7	0.0	3.9	0.0
Cardamine rupicola	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Castilleja miniata/miniata	10.8	0.1	17.6	0.9	16.7	0.2	0.0	0.0	33.3	2.6	15.0	0.1	0.0	0.0
Castilleja sulphurea	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Castilleja spp.	0.0	0.0	5.9	0.0	5.6	0.0	0.0	0.0	16.7	0.1	10.0	0.1	13.7	0.1
Cerastium arvense	1.5	0.0	9.8	0.1	0.0	0.0	27.3	0.3	16.7	0.1	6.7	0.0	7.8	0.0
Cerastium berringianum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cerastium spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chenopodium chenopodioides	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chenopodium spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Chrysopsis villosa/foliosa	0.0	0.0	2.0	0.0	0.0	0.0	36.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Cicuta douglasii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	5.9	0.1
Cirsium arvense/horridum	0.0	0.0	2.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	10.0	0.1	13.7	0.1
Cirsium scariosum	4.6	0.1	7.8	0.1	5.6	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Cirsium vulgare	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Cirsium spp.	9.2	0.1	13.7	0.1	5.6	0.0	0.0	0.0	33.3	0.5	25.0	0.5	29.4	0.4
Clematis hirsutissima	6.2	0.0	3.9	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Claytonia lanceolata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Claytonia megarhiza	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Collinsia parviflora	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Comandra umbellata	0.0	0.0	3.9	0.1	0.0	0.0	27.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component (10=Closed Timber, 17=Open Timber, 18=Timbered Shrubfield, 11=Limber Pine Savanna, 16=Riparian Complex, 14=Populus Stand, 15=Riparian Shrub).

SPECIE	10 %F	10 CC	17 %F	17 CC	18 %F	18 CC	11 %F	11 CC	16 %F	16 CC	14 %F	14 CC	15 %F	15 CC
Conringia orientalis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Corallorhiza striata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Cruciferae spp.	3.1	0.0	3.9	0.0	0.0	0.0	9.1	0.0	0.0	0.0	1.7	0.2	2.0	0.0
Cryptantha interrupta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cryptantha spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cynoglossum officinale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	0.0
Cypripedium calceolus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Cypripedium montanum	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	2.0	0.0
Delphinium biocolor	1.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	2.0	0.0
Delphinium spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Disporum trachycarpum	1.5	0.0	2.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	5.0	0.1	0.0	0.0
Dodecatheon conjugens	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Dodecatheon pulchellum	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Douglasia montana	1.5	0.0	0.0	0.0	0.0	0.0	18.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Draba oligosperma/oligosperma	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Draba paysonii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Draba spp.	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Epilobium angustifolium	13.8	0.1	25.5	0.3	44.4	0.7	0.0	0.0	66.7	2.8	5.0	0.1	5.9	0.0
Epilobium glandulosum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Erigeron aureus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Erigeron compositus/glabratus	1.5	0.0	2.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	1.7	0.0	2.0	0.0
Erigeron speciosus/speciosus	3.1	0.0	13.7	0.1	11.1	0.1	9.1	0.0	0.0	0.0	6.7	0.0	5.9	0.0
Erigeron spp.	6.2	0.1	13.7	0.1	22.2	0.2	36.4	0.2	0.0	0.0	1.7	0.0	2.0	0.0
Eriogonum flavum/flavum	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eriogonum heracleoides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eriogonum ovalifolium/macropodum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eriogonum umbellatum/subalpinum	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eriogonum spp.	1.5	0.0	7.8	0.1	0.0	0.0	0.0	0.0	16.7	0.1	0.0	0.0	0.0	0.0
Eriophyllum lanatum	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eritrichium howardii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Erysimum asperum	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Erythronium grandiflorum	26.2	0.6	21.6	0.5	11.1	0.9	0.0	0.0	0.0	0.0	20.0	0.7	5.9	0.4
Euphorbia esula	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.3	2.0	0.0
Fragaria virginiana/glauca	44.6	1.6	62.7	1.6	61.1	2.1	18.2	0.3	83.3	9.0	81.7	1.6	56.9	0.9
Frasera speciosa	0.0	0.0	2.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fritillaria pudica	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gaillardia aristata	0.0	0.0	3.9	0.0	0.0	0.0	36.4	0.4	0.0	0.0	1.7	0.0	2.0	0.0
Galium boreale	26.2	0.7	45.1	0.3	27.8	0.9	81.8	3.4	33.3	6.7	65.0	1.0	56.9	0.5
Galium triflorum	7.7	0.1	3.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	26.7	0.2	31.4	0.2
Gentiana affinis	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gentiana amarella	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gentiana calycosa	15.4	0.1	17.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gentiana spp.	6.2	0.0	5.9	0.1	11.1	0.1	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Geranium richardsonii	4.6	0.1	9.8	0.0	0.0	0.0	0.0	0.0	33.3	0.5	18.3	0.2	17.6	0.1
Geranium viscosissimum/	4.6	0.1	15.7	0.1	5.6	0.0	27.3	0.3	16.7	0.1	25.0	0.2	33.3	0.2
Geranium spp.	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component (10=Closed Timber, 17=Open Timber, 18=Timbered Shrubfield, 11=Limber Pine Savanna, 16=Riparian Complex, 14=Populus Stand, 15=Riparian Shrub).

SPECIE	10 %F	10 CC	17 %F	17 CC	18 %F	18 CC	11 %F	11 CC	16 %F	16 CC	14 %F	14 CC	15 %F	15 CC
Geum aleppicum	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0
Geum macrophyllum/macrophyllum	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	5.9	0.0
Geum triflorum/triflorum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.5	0.0	0.0
Glycyrrhiza lepidota/lepidota	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.3	2.0	0.3
Guttierrezia sarothrae	0.0	0.0	0.0	0.0	0.0	0.0	18.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Habenaria dilatata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.4	3.3	0.0	0.0	0.0
Habenaria spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0
Habenaria viridis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hackelia floribunda	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	3.9	0.0
Hedysarum alpinum	1.5	0.0	2.0	0.0	33.3	1.8	0.0	0.0	16.7	0.1	0.0	0.0	0.0	0.0
Hedysarum boreale/cinerascens	4.6	0.2	13.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Hedysarum spp.	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hedysarum sulphurescens	7.7	0.3	2.0	0.0	5.6	0.1	27.3	0.3	0.0	0.0	1.7	0.0	2.0	0.0
Helianthella uniflora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Helianthus annuus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Helianthus nuttallii/nutallii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Helianthus spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.1	0.0	0.0	0.0	0.0
Heracleum lanatum	15.4	0.5	19.6	0.8	0.0	0.0	0.0	0.0	66.7	3.1	26.7	1.2	31.4	3.6
Heuchera cylindrica/glabella	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heuchera parvifolia/dissecta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heuchera spp.	3.1	0.0	5.9	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hieracium gracile	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hieracium spp.	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydrophyllum capitatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Hymenoxys acaulis/acaulis	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Iris missouriensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3	0.3	7.8	0.0
Ivesia gordonii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lactuca pulchella	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	3.9	0.0
Lathyrus ochroleucus	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.4	0.0	0.0	0.0	0.0
Lathyrus spp.	7.7	0.1	2.0	0.0	5.6	0.1	9.1	0.2	0.0	0.0	13.3	0.2	9.8	0.0
Leguminosae	0.0	0.0	3.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lesquerella alpina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ligusticum spp.	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Ligusticum verticillatum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	2.0	0.0
Linum perenne/lewisii	0.0	0.0	0.0	0.0	0.0	0.0	18.2	0.3	0.0	0.0	1.7	0.0	0.0	0.0
Lithospermum ruderale	1.5	0.0	3.9	0.0	5.6	0.0	63.6	1.8	0.0	0.0	3.3	0.0	0.0	0.0
Lomatium cous	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lomatium dissectum/multifidum	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lomatium geyeri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lomatium macrocarpum	0.0	0.0	3.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lomatium spp.	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lupinus sericeus/sericeus	6.2	0.1	19.6	0.3	11.1	0.9	36.4	2.0	16.7	0.1	3.3	0.0	2.0	0.0
Madia spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Medicago lupulina	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	2.0	0.0
Medicago sativa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Melilotus alba	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component
(10=Closed Timber, 17=Open Timber, 18=Timbered Shrubfield,
11=Limber Pine Savanna, 16=Riparian Complex, 14=Populus
Stand, 15=Riparian Shrub).

SPECIE	10	10	17	17	18	18	11	11	16	16	14	14	15	15
	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC
Melilotus officinalis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	7.8	0.1
Mentha arvensis/glabrata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	13.7	0.1
Menyanthes trifoliata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3
Mertensia ciliata/ciliata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mertensia longiflora	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mitella breweri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Monarada fistulosa/menthifolia	3.1	0.0	3.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.3	9.8	0.2
Myosotis arvensis	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	7.8	0.0
Orthocarpus tenuifolius	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.2	0.0	0.0	0.0	0.0	2.0	0.0
Osmorhiza chilensis	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.1	2.0	0.0
Osmorhiza occidentalis	18.5	0.2	21.6	0.2	11.1	0.2	0.0	0.0	0.0	0.0	26.7	0.9	7.8	0.2
Osmorhiza spp.	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	16.7	6.2	15.0	0.1	2.0	0.0
Oxytropis bessayi	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oxytropis sericea/spicata	1.5	0.0	0.0	0.0	0.0	0.0	18.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Oxytropis splendens	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oxytropis viscida	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Oxytropis spp.	0.0	0.0	2.0	0.0	0.0	0.0	18.2	0.1	0.0	0.0	0.0	0.0	2.0	0.0
Parnassia fimbriata/fimbriata	1.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	16.7	0.1	1.7	0.0	2.0	0.0
Parnassia palustris	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Pastinaca sativa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Pedicularis bracteosa	3.1	0.0	3.9	0.0	5.6	0.0	0.0	0.0	66.7	0.3	5.0	0.0	2.0	0.0
Pedicularis contorta/contorta	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pedicularis groenlandica	7.7	0.0	3.9	0.0	11.1	0.1	0.0	0.0	0.0	0.0	3.3	0.0	2.0	0.3
Pedicularis racemosa	3.1	0.1	3.9	0.1	11.1	0.1	0.0	0.0	16.7	0.1	0.0	0.0	0.0	0.0
Pedicularis spp.	6.2	0.0	7.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.1	3.9	0.0
Penstemon confertus	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Penstemon davidsonii/menziesia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Penstemon eriantherus/eriantherus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	2.0	0.0
Penstemon nitidus/nitidus	4.6	0.1	2.0	0.0	0.0	0.0	18.2	1.4	0.0	0.0	1.7	0.0	0.0	0.0
Penstemon procerus/procerus	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Penstemon spp.	1.5	0.0	7.8	0.1	0.0	0.0	9.1	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Phacelia sericea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phacelia lyalli	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phlox hoodii	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Phlox spp.	0.0	0.0	9.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Physaria didymocarpa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Plantago eriopoda	0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Polemonium occidentale	0.0	0.0	2.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polemonium pulcherrimum	0.0	0.0	3.9	0.0	0.0	0.0	18.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Polygonum bistortoides	1.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	2.0	0.0
Potentilla glandulosa	1.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	16.7	0.1	3.3	0.0	2.0	0.0
Potentilla gracilis/glabrata	6.2	0.1	13.7	0.1	5.6	0.0	18.2	0.1	0.0	0.0	5.0	0.1	2.0	0.0
Potentilla gracilis/flabelliformis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	2.0	0.0
Potentilla ovina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Potentilla spp.	0.0	0.0	2.0	0.0	0.0	0.0	9.1	0.0	16.7	0.1	0.0	0.0	2.0	0.0
Primula incana	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component (10=Closed Timber, 17=Open Timber, 18=Timbered Shrubfield, 11=Limber Pine Savanna, 16=Riparian Complex, 14=Populus Stand, 15=Riparian Shrub).

SPECIE	10	10	17	17	18	18	11	11	16	16	14	14	15	15
	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC	%F	CC
Pyrola chlorantha	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrola minor	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrola secunda	10.8	0.3	7.8	0.3	5.6	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Pyrola uniflora	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pyrola spp.	4.6	0.0	0.0	0.0	11.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ranunculus glabberimus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.2	0.0	0.0
Ranunculus spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	2.0	0.0
Rumex crispus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Sanicula marilandica	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Saxifraga bronchialis/austromontana	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saxifraga oppositifolia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Saxifraga rhomboidea	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sedum lanceolatum/lanceolatum	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sedum stenopetalum	0.0	0.0	3.9	0.0	5.6	0.0	18.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Sedum spp.	3.1	0.0	3.9	0.0	0.0	0.0	9.1	0.0	16.7	0.1	1.7	0.0	0.0	0.0
Senecio canus	0.0	0.0	3.9	0.1	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Senecio fremontii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Senecio indecorus	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Senecio pauperculus	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	3.9	0.1
Senecio spp.	3.1	0.0	3.9	0.1	11.1	0.2	18.2	0.1	0.0	0.0	3.3	0.0	3.9	0.0
Senecio triangularis/trianyularis	13.8	0.4	13.7	0.3	16.7	0.1	0.0	0.0	66.7	6.5	10.0	0.1	5.9	0.4
Sibbaldia procumbens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Silene acaulis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Smilacina racemosa	10.8	0.1	13.7	0.1	11.1	0.1	0.0	0.0	0.0	0.0	26.7	0.3	17.6	0.2
Smilacina stellata	7.7	0.2	9.8	0.0	0.0	0.0	9.1	0.0	0.0	0.0	36.7	0.2	41.2	0.2
Solidago canadensis/salebrosa	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.1	3.9	0.7
Solidago missouriensis/	4.6	0.1	7.8	0.0	5.6	0.0	9.1	0.0	0.0	0.0	8.3	0.4	2.0	0.0
Solidago multiradiata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Solidago spp.	1.5	0.0	7.8	0.0	16.7	0.2	36.4	0.2	33.3	0.2	15.0	0.1	27.5	0.2
Spiranthes romanzoffiana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	5.9	0.0
Stachys palustris/pilosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Streptopus amplexifolius/chalazatus	15.4	0.4	7.8	0.0	5.6	0.0	0.0	0.0	0.0	0.0	18.3	0.1	11.8	0.1
Taraxacum officinale	12.3	0.8	17.6	0.1	11.1	0.2	45.5	0.4	33.3	0.2	71.7	1.9	64.7	1.9
Taraxacum spp.	0.0	0.0	0.0	0.0	5.6	0.1	0.0	0.0	33.3	0.2	5.0	0.1	0.0	0.0
Thalictrum occidentale	60.0	4.1	52.9	2.9	50.0	0.5	0.0	0.0	83.3	5.2	65.0	1.9	56.9	0.8
Townsendia parryi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tragopogon dubius	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Trifolium longipes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Trifolium pratense	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trifolium repens	1.5	0.2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.1	3.9	0.3
Trifolium spp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.3	17.6	0.1
Urtica dioica ssp. gracilis/gracilis	1.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.2	3.9	0.1
Urtica dioica ssp. gracilis/procera	1.5	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	20.0	0.5	15.7	0.2
Unknown forb	23.1	0.2	25.5	0.3	22.2	0.1	36.4	0.5	33.3	0.2	35.0	0.8	27.5	0.2
Valeriana dioica	7.7	0.0	5.9	0.0	11.1	0.1	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Valeriana occidentalis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix F. Vegetation plot summary by habitat component (10=Closed Timber, 17=Open Timber, 18=Timbered Shrubfield, 11=Limber Pine Savanna, 16=Riparian Complex, 14=Populus Stand, 15=Riparian Shrub).

SPECIE	10 %F	10 CC	17 %F	17 CC	18 %F	18 CC	11 %F	11 CC	16 %F	16 CC	14 %F	14 CC	15 %F	15 CC
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Valeriana sitchensis	12.3	0.2	17.6	0.2	11.1	0.1	0.0	0.0	16.7	0.1	1.7	0.0	0.0	0.0
Valeriana spp.	3.1	0.0	7.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Veratrum viride	20.0	0.4	17.6	0.2	11.1	0.2	0.0	0.0	66.7	3.1	5.0	0.0	3.9	0.1
Vicia americana/truncata	7.7	0.3	3.9	0.1	0.0	0.0	0.0	0.0	16.7	2.5	16.7	0.2	7.8	0.4
Vicia sativa	1.5	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	21.7	0.5	11.8	0.1
Vicia spp.	6.2	0.1	13.7	0.1	5.6	0.8	0.0	0.0	16.7	0.1	30.0	0.2	33.3	0.2
Viola adunca	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0
Viola canadensis/rugulosa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.1	0.0	0.0
Viola glabella	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.2	2.0	0.0
Viola orbiculata	6.2	0.1	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	5.0	0.1	3.9	0.0
Viola spp.	24.6	0.2	11.8	0.1	33.3	0.2	0.0	0.0	33.3	0.2	38.3	0.4	49.0	0.3
Xerophyllum tenax	44.6	11.1	35.3	11.1	61.1	14.9	0.0	0.0	50.0	13.0	0.0	0.0	0.0	0.0
Zigadenus elegans	7.7	0.0	9.8	0.0	11.1	0.1	18.2	0.1	0.0	0.0	5.0	0.0	3.9	0.1
Zigadenus venenosus/gramineus	0.0	0.0	2.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	1.7	0.0	0.0	0.0
Total forbs	98.5	35.9	100.0	31.8	100.0	43.5	100.0	19.1	100.0	45.8	100.0	22.0	100.0	20.3
Moss	32.3	2.0	17.6	1.2	22.2	3.9	0.0	0.0	16.7	0.4	10.0	0.1	15.7	0.4
Mineral Soil	87.7	10.0	94.1	10.8	88.9	3.5	63.6	5.4	33.3	2.6	61.7	4.1	66.7	1.7
Rock	58.5	2.7	70.6	4.1	83.3	1.4	45.4	2.1	50.0	17.1	21.7	1.0	7.8	0.3
*** Total ***								218.3						

Appendix G. Grizzly bear management guidelines, East Slope, Rocky Mountain Front. (Excerpted from Interagency Rocky Mountain Front Management Guidelines, 1987)

The Interagency Grizzly Bear Committee approved the application of guidelines on National Forest System, Bureau of Land Management (BLM) and National Park System lands throughout grizzly bear ecosystems in the States of Idaho, Montana, Washington, and Wyoming (November 26, 1986 Federal Register, Vol. 51, No. 228). These guidelines are known as the Interagency Grizzly Bear Guidelines (IGBG). The IGBG provide definition and management direction for grizzly bear Management Situations I, II, III, IV and V and further provide generalized guidelines on "how to coordinate various activities with the bear in various activities with the bear in the various management situations. Grizzly bear habitat along the Rocky Mountain Front has been stratified into grizzly bear management situations pursuant to the IGBG.

The Rocky Mountain Front Guidelines (RMFG) found in this document do not identify management situations or provide definitions or management directions of the stratification. The Management Situations designated on the Front pursuant to the IGBG identify where the emphasis on grizzly bear needs to be placed, and if there is a conflict, where the conflict should be resolved in favor of the bear. The RMFG represent best management practices for coordinating multiple use activities within the grizzly bear management situations delineated on the Front. The RMFG are detailed coordination measures for specific activities that will assist land managers in meeting the management direction provided in the IGBG. They are consistent with the IGBG and further refine the IGBG to specific habitat conditions on the Front.

Study results documented to date along the east Rocky Mountain Front are the basis for the development of management guidelines for grizzly bear and their habitat. During the period from 1977-1979, research was carried out by the Border Grizzly Project under a contract with the BLM.

Since 1980 the Montana Department of Fish, Wildlife and Parks has assumed the intensive grizzly bear monitoring work with funding continuing from the Interagency Rocky Mountain Front Task Force, private industry (ARCO, Mobil Oil Corporation, Shell Oil, American Petrofina, Williams Exploration, Sun Exploration) and the Nature Conservancy. In addition, a BLM funded livestock/grizzly bear interaction study was conducted by a graduate student from Montana State University during the field seasons of 1985 and 1986.

These guidelines were developed as a direct result of grizzly bear monitoring conducted on the East Front. They represent guidelines that, when followed, will mitigate but not totally eliminate influences of human activities on grizzly bears and grizzly bear habitat. Human activities within grizzly bear range will have effects, however subtle, on grizzly bears.

All previously mentioned "general management guidelines" are applicable coordination measures that should be considered when evaluating human activities in grizzly bear habitat. The following are additional species specific guidelines.

1. Avoid human activities in identified grizzly bear habitat constituent elements or portions of constituent elements containing specific habitat values during the following seasonal use periods (see data summarization):

   A.Spring habitat (concentrated use areas)....April 1-June 30
   B.Alpine feeding sites........................July 1-Sept 15
   C.Subalpine fir/whitebark pine habitat types...Aug 1-Nov. 30
   D.Denning habitat.............................Oct 15-Apr. 15

2. Avoid human activities in grizzly bear habitat components which provide important food sources during spring and early summer, April 1 - July 15. These habitat components include riparian shrub types, Populus stands, wet meadows, sidehill parks, and avalanche chutes. Maintain an undisturbed zone of at least 1/2 mile between activities and the edge of these habitat components where many important bear foods occur.

3. Establish flight patterns in advance when activities require the use of helicopters. Flight patterns should be located to avoid seasonally important grizzly bear habitat constituent elements and habitat components during the designated seasonal use periods.

4. No seismic or exploratory drilling activities should be conducted within a minimum of one mile of den sites during the October 15 - April 15 period (Reynolds, P.E. et al., 1983).

5. Seismic permits should include a clause providing for cancellation or temporary cessation of activities, if necessary, to prevent grizzly/human conflicts.

6. Scheduling of well drilling on adjacent sites, within important grizzly bear use areas, should be staggered to provide a disturbance free area for displaced bears.

7. Pipeline construction required for the development of a gas or oil field should be condensed into the shortest time frame possible and subject to seasonal restrictions when conducted in important grizzly bear habitat.

8. Field operation centers associated with seismic or oil/gas exploration activities should be placed carefully to avoid seasonally important habitat components or constituent elements. Such placement of sites is necessary in order to avoid direct or potential conflicts between man and grizzly bear.

9. Retain frequent dense cover areas adjacent to roads for travel corridors and security cover necessary to protect important habitat components. Three sight distances are desirable to provide visual security for grizzlies. A sight distance is the average distance at which a grizzly or other large animal is essentially hidden from the view of an observer by vegetation cover. The same security cover guidelines also applies to timber harvest units.

10. No off-duty work camps will be allowed within occupied seasonally important constituent elements.

11. Incinerate garbage daily or store in bear-proof containers and remove to local landfill dumps daily.

12. Commercial activities permitted on public land should be planned and coordinated to avoid conflicts with grizzly bear trapping operations being conducted under the monitoring program. General public use of areas where trapping operations are active will be controlled through appropriate administrative actions by the agencies involved.

The following are grizzly bear management guidelines specifically oriented toward livestock grazing:

1. Livestock grazing on riparian plant communities should be deferred until after July 1.

2. In pastures grazed after July 1, cattle should be removed before the amount of the riparian forage base is reduced by 50 percent by either grazing or structural damage.

3. Exceptions to the July 1 entry date can be made when a pasture is part of a grazing system (for example, rest rotation or deferred rest rotation) that does not cause a decrease in the condition or size of the riparian plant communities.

4. In riparian habitats that receive high amounts of bear use, fencing to exclude livestock grazing and trampling may be necessary where livestock turn-out dates prior to July 1 are allowed.

5. Boneyards and livestock dumps are prevalent along the East Front and are frequented by grizzly bears. Ranchers and landowners should be encouraged to place carcasses of dead livestock and garbage on remote areas of their land. Dead cows and calves should be hauled a considerable distance from calving grounds to discourage bears from feeding on carrion and newborn calves.

6. Options given in the IGBG for sheep allotments will be followed: "On sheep allotments where grizzly -- livestock

depredation has been authenticated, adjustments will be made for the primary purpose of grizzly bear conservation. The following options are available:

(a) change the season of use, bedding practices, or grazing area to avoid known problem areas or other habitat important to grizzlies in time and space;

(b) change the class of livestock from sheep to cattle if the range is suitable for cattle; or

(c) remove all livestock and close the allotment. Vacant sheep allotments will not be restocked with sheep."

In addition to the guidelines listed above for livestock grazing practices,the following research/management recommendations are presented; and will be considered as allotment management plans are updated.

1. The condition and trend of all riparian plant communities and their production of Angelica arguta, Heracleum lanatum, and Osmorhiza occidentalis need to be determined on all east front public lands grazed by livestock.

2. For pastures where the condition of riparian plant communities needs improving, the construction of special use pastures is recommended. A special use pasture should be constructed where large areas of riparian vegetation are enclosed so an adequate forage base will be available to allow for stocking rates compatible with livestock operations (Exclosures should be considered if riparian areas are too small). These pastures should only be grazed after July 1, and the livestock should be removed before the utilization of the riparian forage base reached 50 percent or the special use pastures should be incorporated into a deferred rest rotation grazing system similar to that described by Marlow (1985). Some other methods which may be used to reduce impacts to riparian include; development of alternate water sources, placement of salt away from riparian, and improved herding practices.

3. For riparian areas where the abundance of important plant species used by grizzlies for cover (Populus tremuloides, Populus tricocarpa, Salix spp., or Betula spp.) or food (Angelica arguta, Heracleum lanatum, or Osmorhiza occidentalis) has been reduced, reestablishment should be attempted.